COLLEGE OF ENGINEERING CORNELL UNIVERSITY

the Cornell engineer

NOVEMBER, 1956
VOL. 22, NO. 2
25 CENTS

Leroy J. Sauter, class of '49,
speaks from experience when he says:

"The variety of jobs open to engineers with United States Steel offers satisfaction and a great future."

IN 1949, Leroy J. Sauter was graduated from the University of Pittsburgh with a B.S. in Metallurgical Engineering. Today, Mr. Sauter holds the important post of Superintendent, Open Hearth and Bessemer Department at National Works of United States Steel's National Tube Division.

Before his college days, and as far back as October, 1939, Mr. Sauter was employed as a chipper, a molding helper, and helper on an electric furnace at the United States Steel's Johnstown Works. Then, from 1943 until 1945, he served in the U. S. Navy. He entered the University of Pittsburgh in 1946, graduating within three years.

In February of 1949, Mr. Sauter was employed by United States Steel as a student engineer. In October, 1950, he became a process engineer in the Open Hearth and Bessemer Department. In April, 1952, he was advanced to practice engineer in the same department, and three months later, July, 1952, Mr. Sauter was appointed Assistant Superintendent of the Open Hearth and Bessemer Department. His elevation to his present position of Superintendent of this department occurred in December, 1955.

Today, Mr. Sauter supervises 316 men, being responsible for and assuring the productivity, quality of product, and general morale of this group. His responsibility further extends to the complete operation of his department, operating costs, meeting ingot requirements and complete scheduling of equipment.

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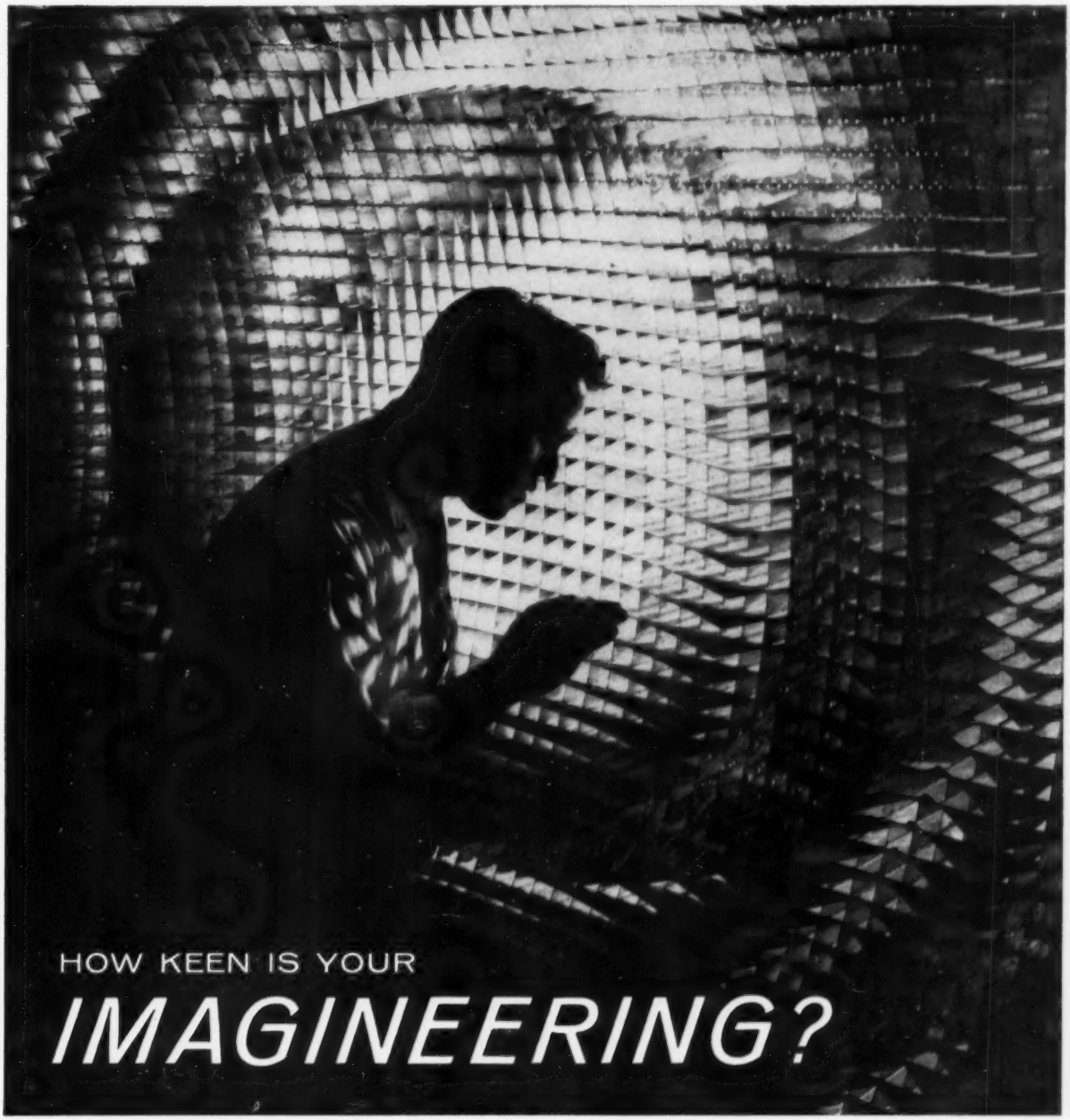

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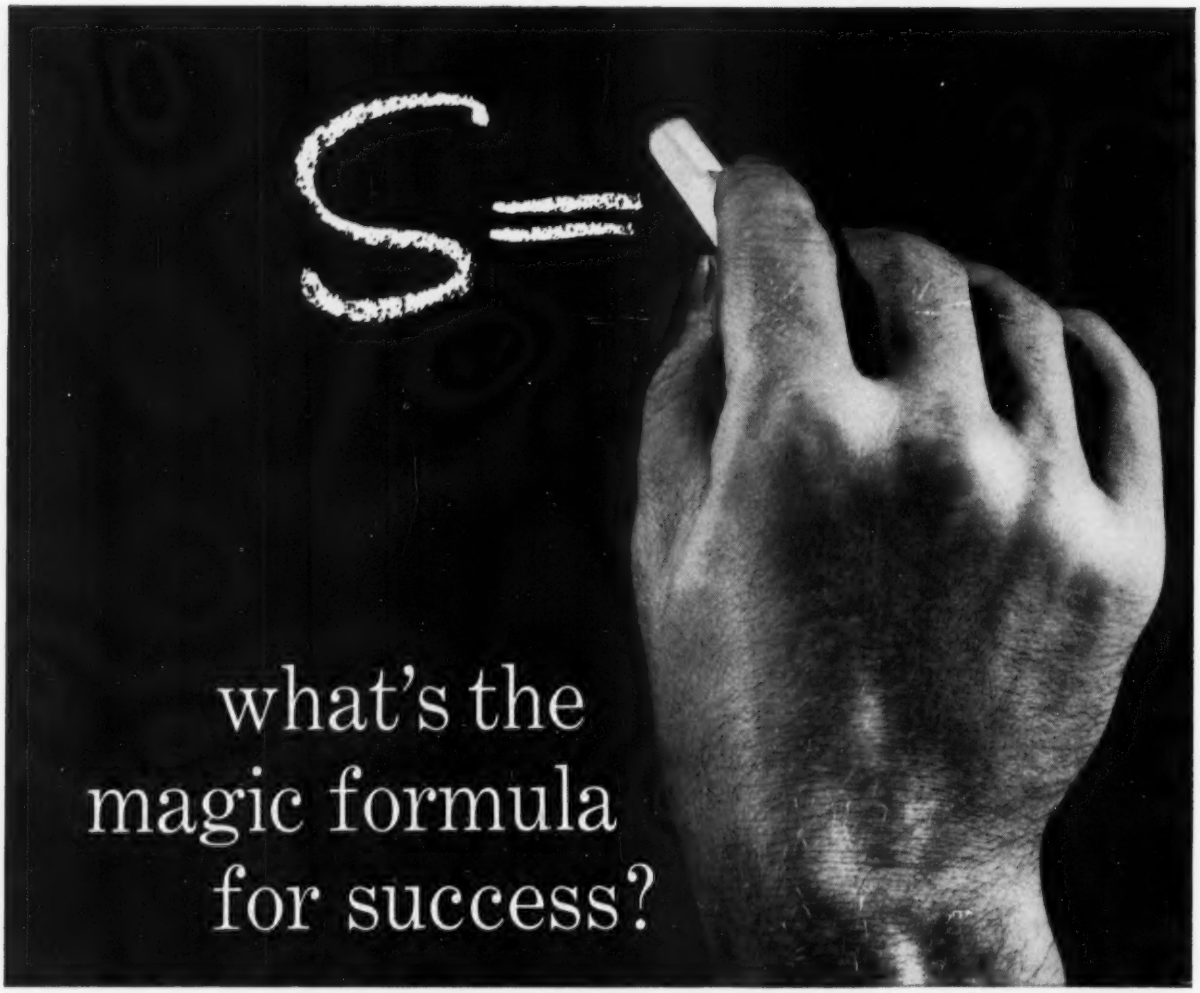

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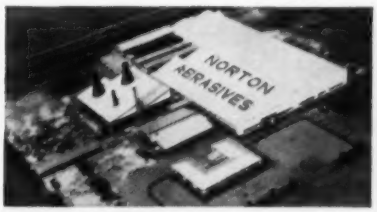

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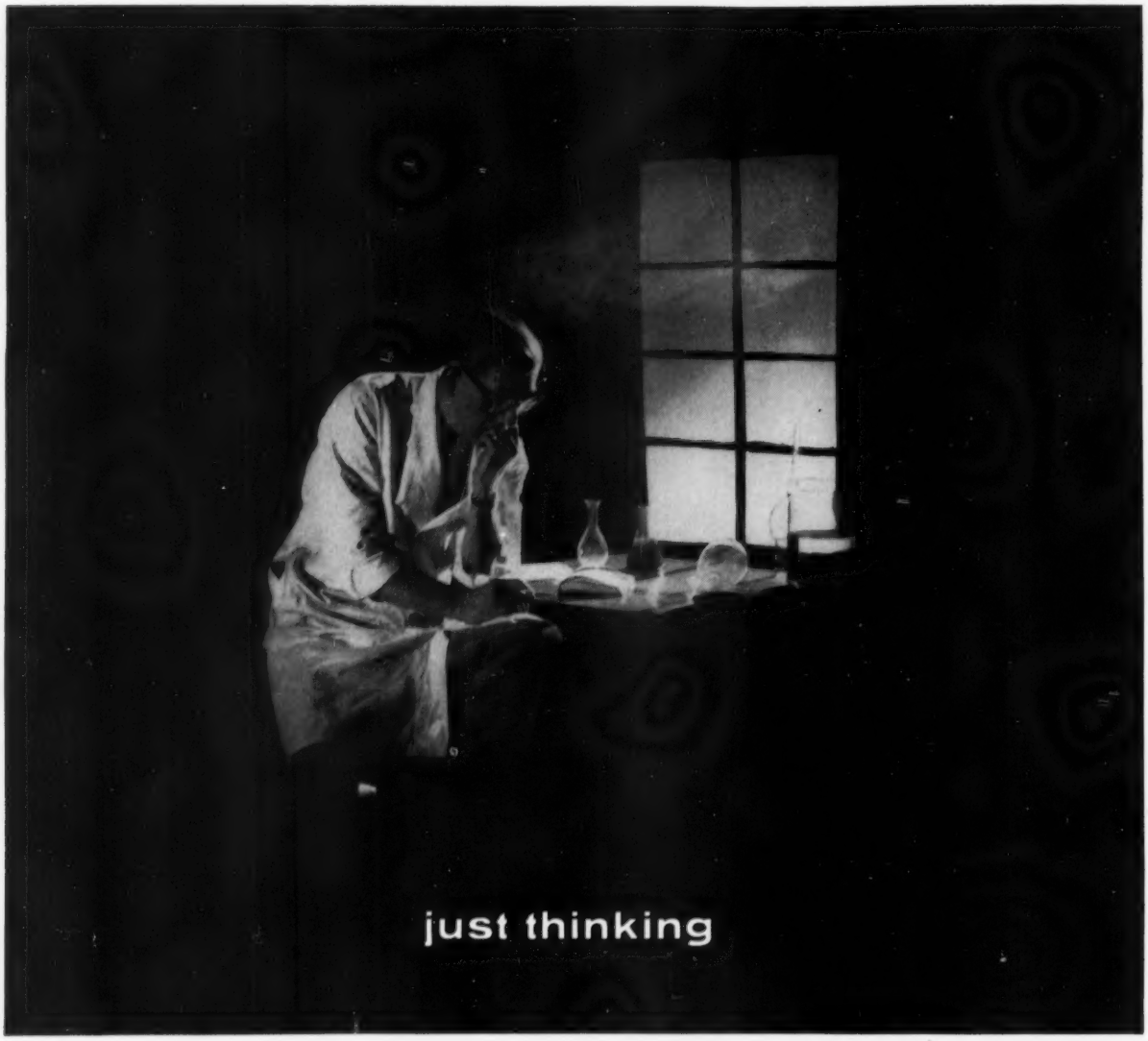

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Editorial . . .

The Engineer, A Community Citizen

"The punishment suffered by the wise who refuse to take part in government is to live under the government of bad men."—Plato

Maybe today Plato could be revised to read "The punishment suffered by scientists and engineers who refuse to take part in government is to live in a scientific world under the government of laymen." Of most direct and immediate concern to the American citizen is the local government of his community, the city council, the school board, civil defense, the PTA, the hospital board. Every one of these organizations would benefit from the membership of engineers and scientists.

The engineer is ideally equipped for community work. He is as well or better educated than the people with whom he will deal, and he has the additional qualification of an objective, scientific mind. When approached with a problem he will accept only facts and give a careful analysis of the situation, instead of approaching the problem emotionally or wishfully. An example of this need of a scientific approach to community problems is in the controversy over the fluoridation of drinking water. Here a great medical discovery has been placed in jeopardy because those responsible for decisions are not qualified and so are being guided by their emotions.

Air pollution has become a recent problem in many American communities. In the midst of many conflicting viewpoints, the engineer is probably best qualified to analyze the situation and arrive at the best solution to the problem. But the engineer should not sit back and wait to be invited. He should attend open meetings on this problem and let his opinions be heard.

The national problem of increasing our technical manpower is probably really appreciated only by our present technical people. It is recognized that improved science teaching in our high schools is the first problem to be solved. To have engineers on the school boards pushing this question would be a big step toward its solution. By offering salaries to science teachers competitive with industrial salaries, many capable people would be attracted to teaching. But the school boards must take the initiative.

Civil defense is another opportunity for the engineer to show his civic interest and leadership. There are many problems in civil defense that need to be carefully analyzed and acted upon. A Military Industrial Conference was held this year on defense against atomic and chemical, biological and radiological warfare. It was attended by representatives of the armed forces, industry, science, engineering, government, and education. They saw the need of locating new and expanding industries away from present industrial centers, but this can only be accomplished through forceful leadership on both the federal and local levels.

Community work can be fun for the worker as well as productive for the community. There is a great need for Scoutmasters and leaders of other youth organizations. Here is an opportunity to guide young minds into fertile channels and to develop the leaders of the next generation.

In every American community there are dozens of problems that engineers should be working on with other civic-minded citizens. The difference between a solution based on a careful analysis of facts and a solution based on emotional thinking may be directly traced to engineers, or a lack of engineers, on the committee. Both the community and the engineer will benefit. He will have the satisfaction of doing a good job that was not actually required of him, and he and his family will enjoy the benefits of living under a government of wiser men.—L.T.

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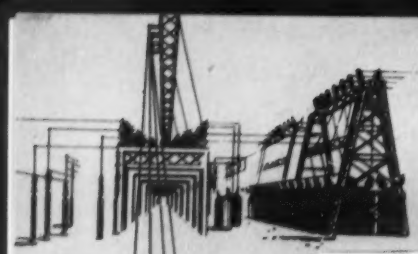
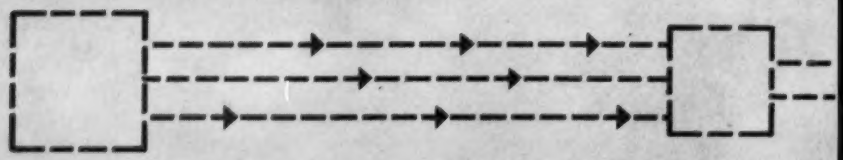




The Importance of

Coverings and Sheaths for

THE TERM "COVERINGS", as applied to insulated electrical wires and cables, refers to a relatively continuous homogeneous layer or layers of impervious and inert material, applied over an insulated conductor or conductor assembly for the purpose of protecting such conductors from moisture, chemical attack and mechanical damage. Coverings may be colored to indicate circuit identification. Chemical attack refers to damage to the insulation resulting from acids, alkalies and other chemicals in the atmosphere, the ducts or soil in which the cables may be installed. Mechanical damage may result from the abrading, compressing, cutting and tearing forces to which the insulation may be subjected during installation and service.

Coverings may be made of metallic or non-metallic materials. Metallic coverings may be, (1) a continuous metal tube over the insulated conductor, usually made of lead and known as a lead sheath, (2) metal tapes applied spirally about the insulated conductor and referred to as an armor or a shield, depending on the purpose for which it is used, or, (3) metal wires applied spirally either in one direction or in the form of a braid, and again known as an armor or a shield. Armor is a covering applied primarily for mechanical protection or to add strength while a shield is applied to protect the insulation from electrical stresses or for safety purposes. Non-metallic coverings may consist of, (1) a continuous layer of vulcanized rubber or rubber-like material, generally neoprene, or a thermoplastic material, called a jacket, (2) spirally applied, moisture-resistant fibrous yarn, usually cotton or jute, (3) moisture-resistant fibrous tapes, or, (4) moisture-resistant fibrous braids. Combinations of two or more of these may be used as explained later.

The kind and number of coverings used is determined largely by the size of the conductor or cable, the type of insulation on the conductor and the installation conditions. The following is a brief outline of the types of coverings required for the more important types of insulations and installation conditions.

INSTALLATION in DRY CONDUITS and DUCTS

Single-conductor rubber and varnished-cambric insulated cables require a covering over the insulation consisting of a moisture-resistant cotton braid on the small sizes and a double braid or tape and braid on the large sizes for protection against mechanical damage. On 600 volt cables for installation in buildings this covering must be flame-resistant, and is usually colored for circuit identification. A thin layer of neoprene may replace such fibrous coverings on rubber-insulated cables. Paper-insulated cables require a lead sheath for retention of the impregnant and for mechanical protection. Single-conductor polyvinyl chloride insulated cables usually require no coverings since they are generally considered resistant to flame and chemical and mechanical damage.

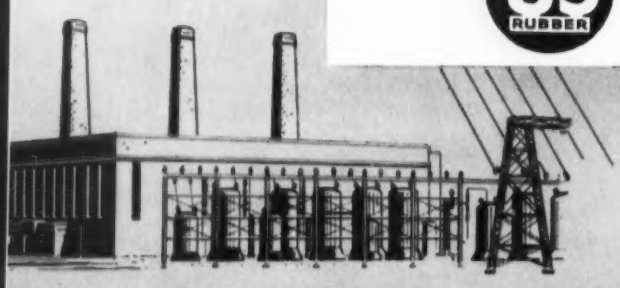
Multiple-conductor cables which consist of two or more single conductors assembled as a unit are protected by an outer covering. The individual conductors of multiple-conductor rubber insulated cables are generally protected by a single fibrous covering. The outer covering of multiple-conductor cables usually consists of a tape and moisture-resistant cotton braid on rubber and varnished-cambric insulated cables. A neoprene jacket may replace the outer braid on rubber-insulated cables. A polyvinyl chloride jacket is generally used on polyvinyl chloride insulated multiple-conductor cables. Multiple-conductor paper-insulated cables have a lead sheath over the assembled insulated conductors.

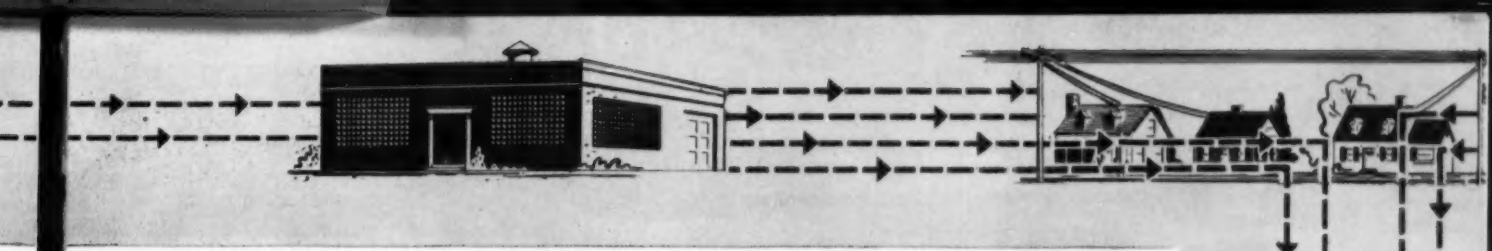
INSTALLATION in WET CONDUITS and DUCTS

The coverings described for use in dry locations on both single- and multiple-conductor cables are suitable for use in wet locations, except that a lead sheath is required over varnished cambric, paper and non-moisture-resistant rubber and polyvinyl chloride insulations.

Moisture-resistant rubber insulation requires mechanical protection in the form of a fibrous covering or coverings or a neoprene jacket. A neoprene jacket is preferred because of its greater resistance to deterioration in wet locations. Moisture-resistant polyvinyl chloride may be

United States Rubber





insulated wires and cables

used without a covering on single-conductor cables.

AERIAL INSTALLATIONS

The types of coverings described for use in wet locations are generally suitable for aerial installations but greater thicknesses of non-metallic coverings, particularly for single-conductor cables, are required. Fibrous coverings for aerial use are usually made of moisture-resistant jute, sisal or loom-woven cotton of large size. Neoprene jackets on single-conductor cables for aerial installations are about 50 per cent greater in thickness than those used for duct installations. These thicker covers provide the additional mechanical protection required for aerial installations. Neoprene jackets are generally preferred over fibrous or rubber jackets because of their greater resistance to weathering. Lead-sheathed cables with the same sheath thickness as used for duct installations are suitable for aerial installations. A lead alloy containing small amounts of antimony or tin is used instead of pure lead to reduce failures due to crystallization.

DIRECT BURIAL

For direct-burial installations, rubber, rubber-like or thermoplastic jackets and lead sheaths are generally used. The jacket or sheath thicknesses are the same as those used for aerial installations. Lead sheaths require protection against mechanical damage. This usually consists of two servings of moisture-resistant jute yarn immediately over the lead, followed by two steel tapes over which are applied two servings of moisture-resistant jute.

SUBMARINE and VERTICAL CABLES

Submarine cables require protection against mechanical damage and additional strength over that provided by the conductors to prevent them from being broken by dragging anchors or other objects. Vertical cables frequently require greater strength for their support than that provided by the conductors. This additional strength and mechanical protection is usually provided by a serving of steel wires which completely covers the surface of the cable. This is known as a wire armor. A bedding consisting of two moisture-resistant jute servings is provided between the non-metallic jacket or lead sheath and the armor wires.

PORTABLE INSTALLATIONS

Cables for portable installations such as those used on dredges, shovels and mining equipment must be flexible and their sheaths must be resistant to abrasion, cutting and tearing. Tough wear-and-weather-resistant rubber or rubber-like jackets are therefore used. Such jackets are generally made in two layers with a reinforcing braid of high-strength cotton yarn between them. The jacket thicknesses for such cables are generally greater for a given size of cable than those of cables for non-portable installations.

SHIELDING

Shields consist of one or more conducting layers on insulated electric power cables, the purpose of which is to confine the dielectric field to the insulation on the individual conductors. The two most important functions of shields are, (1) to protect the insulation against harmful electrical stresses and discharges at its surfaces, and, (2) to reduce hazards of shock.

Since harmful electrical stresses can occur at both the internal and external surfaces of an insulation, particularly on stranded conductors, at high voltages, it is necessary to provide shields at both surfaces. Internal shielding in the form of a semi-conducting fibrous material is generally used immediately over the conductor for operating voltages above 2000. External shielding usually consists of a semi-conducting fibrous layer immediately over the insulation over which is applied a layer of metallic material. External shields are generally used at voltages above 3000 for non-metallic jacket cables and above 10,000 for lead-sheathed cables.

Metallic shields are made of non-magnetic materials such as aluminum or copper and are applied as tapes on cables for non-portable installations and as braids for portable cables. External shields must be grounded at all joints and terminals.

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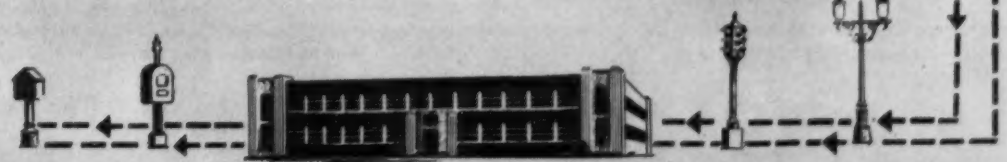

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COVER: Architect's Drawing of Cornell's New Mechanical Engineering Building.

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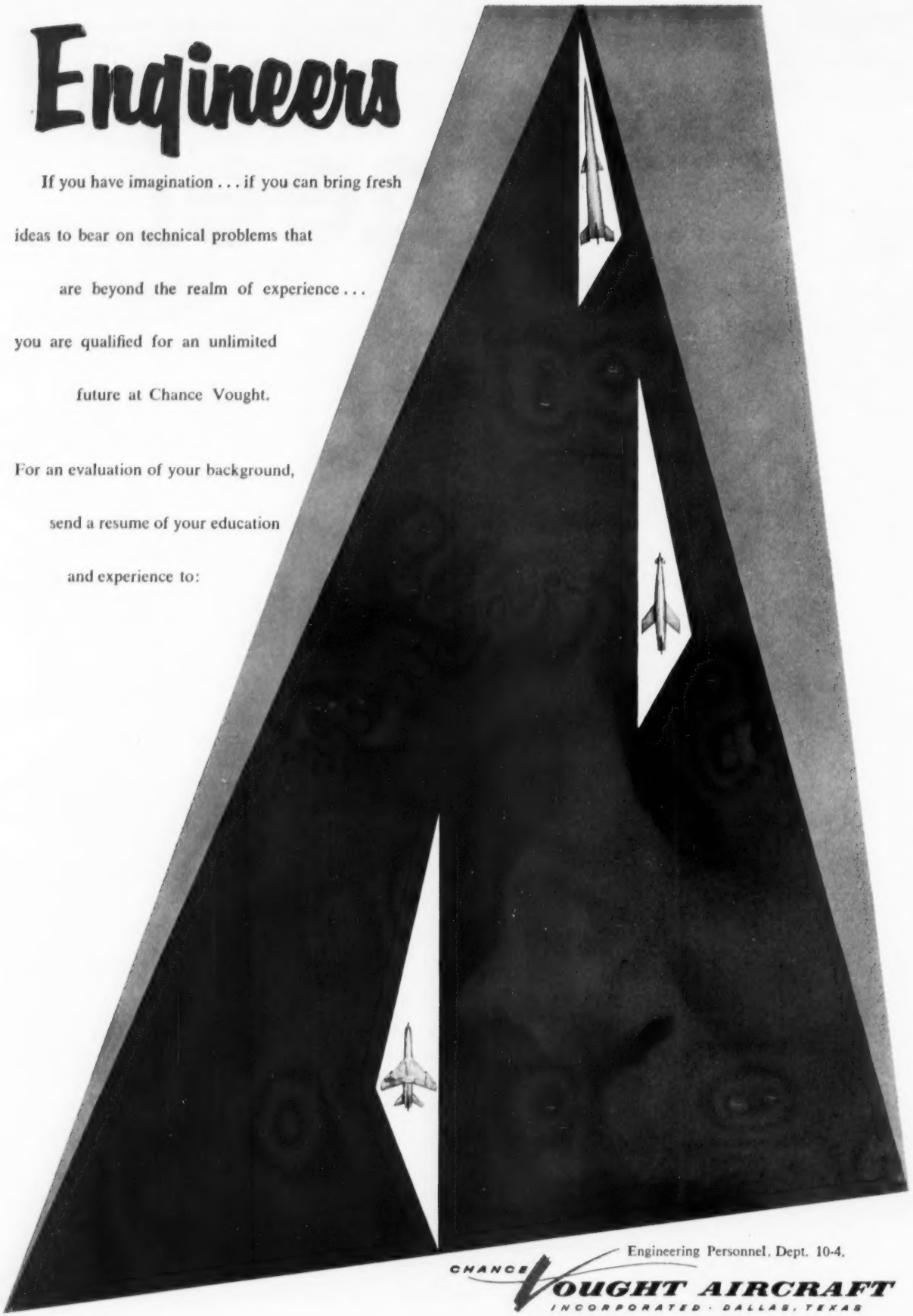

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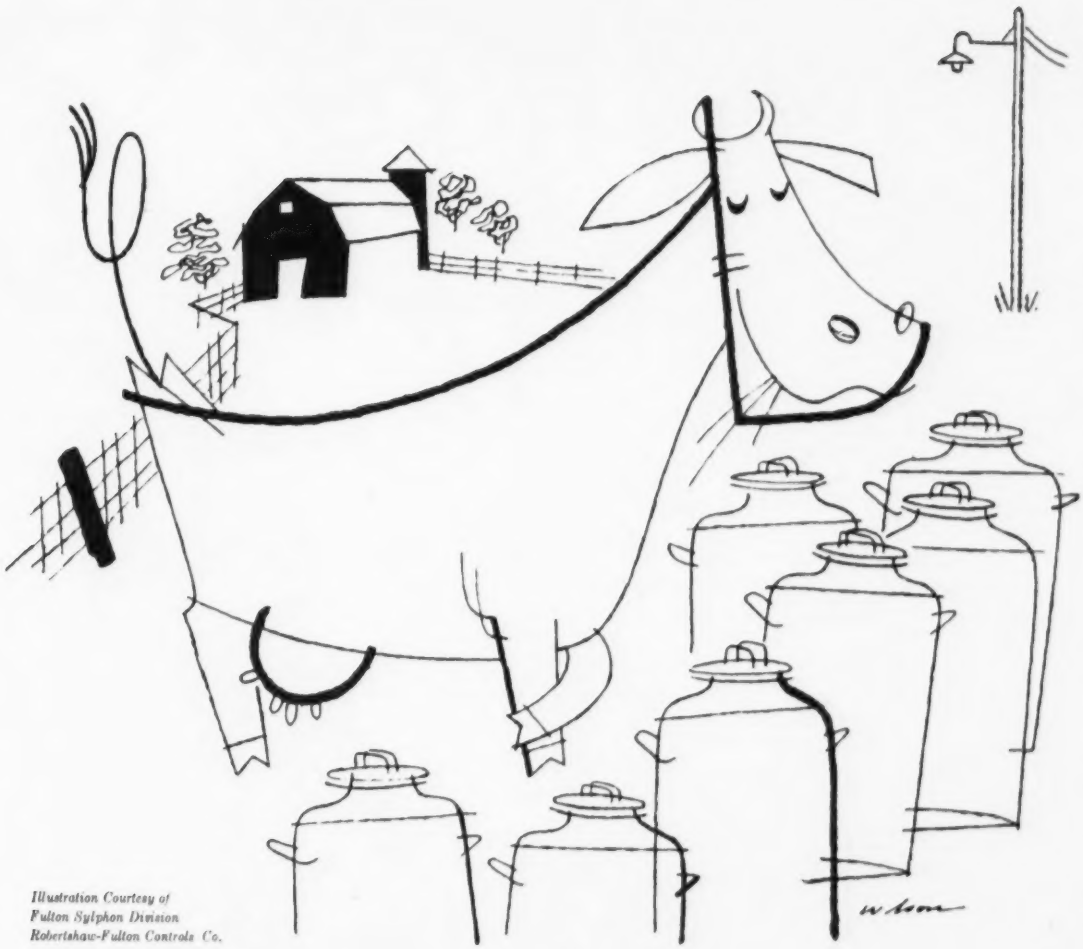

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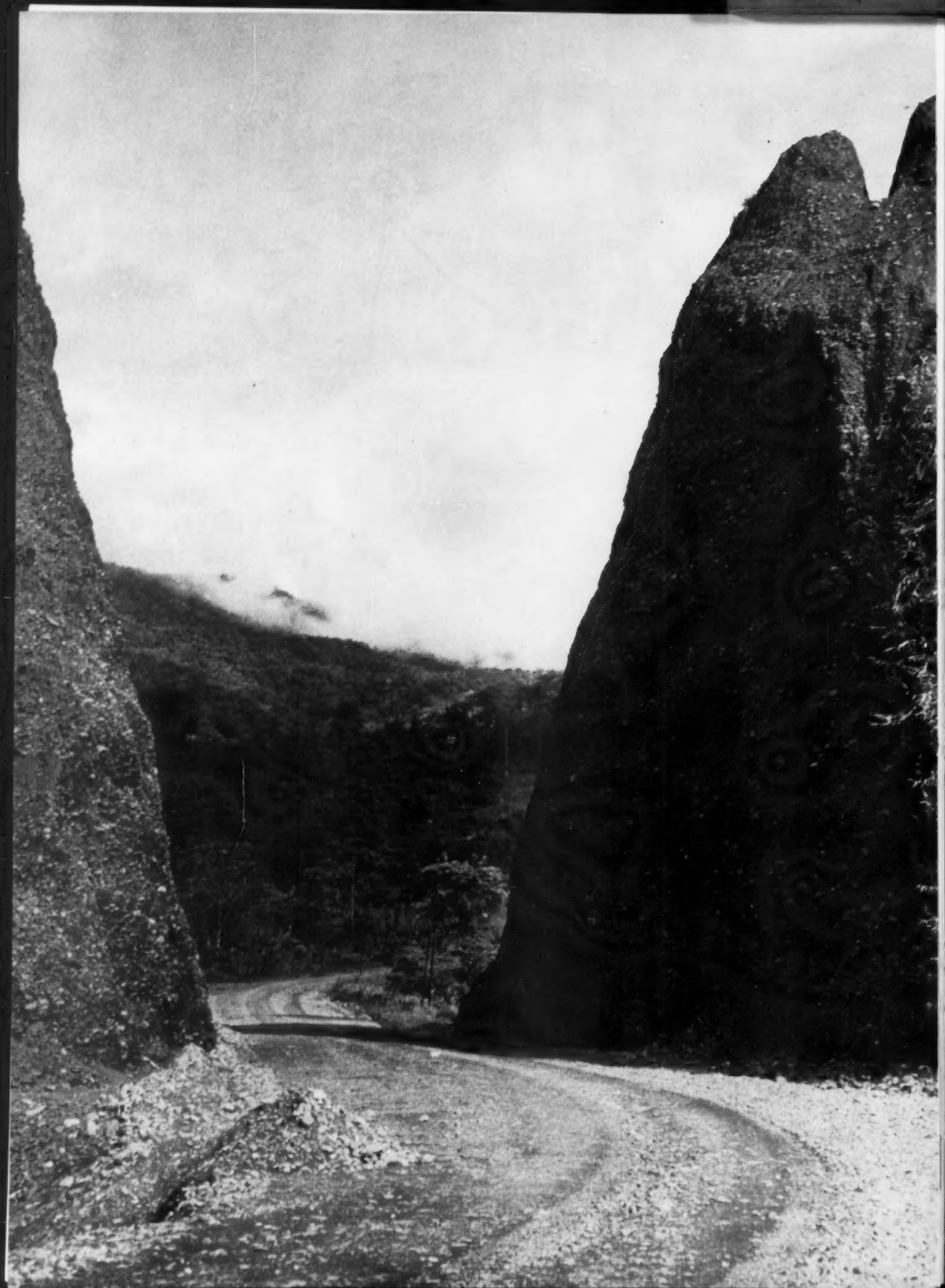


BETTER ROADS

by

M. D. Morris, C.E. '44

(Photos Courtesy of the International Road Federation)

A world boom in highway transportation was just launched in Rome under the most necessary and welcome conditions possible. Roads in the world are not a function solely of engineers and builders. The economic and social aspects, the educational and financial involvements, influence the daily living of every person on earth and plainly demand the attention and services of tried specialists.

Better roads mean better living—this was the ultimate resolve of the Second World Meeting of the International Road Federation in Rome last October. IRF is the candle that has been lighted to pierce the darkness of today's world road communication situation. At this congress, men have done something definite toward improving living conditions and left only the weather to be discussed as unalterable. The participants were professional and business men—practicing experts in their respective fields who had come imbued and left resolved.

Representative George Fallon, (D.-Md.) Chairman of the U.S. Congressional sub-committee on Public Roads, in his address at the meeting's formal dinner, reitterated the urgent desire for a two-party drive to put the President's multi-billion dollar highway program through during the next session of the Congress. Then he asked the European nations to keep step with this plan. Acclaim for both these statements was spontaneous.

←

Buga - Madronal Highway (Colombia) under construction.

Not long ago John W. Johnson, Superintendent of Public Works of the State of New York, published this statement: "For each five miles of highway built, one life can be saved every single year." Depending upon location, better roads mean different things to different peoples. In the United States they mean a holiday weekend without the fruitless 400 mass suicides each time, with the attendant 2000 maimings and uncounted peptic ulcers. Roads are the arteries of intercontinental life lines. For the Afganistani they are a way to the sea and the outside world; for those of the Congo they pave a way to civilization; for Latin American farmers, a shorter way to the markets; and to the heterogeneous Europeans roads mean a firmer way toward lasting peace through easy international and interzonal road travel. Ethnic groups exchanging ideas and visits do much to promote warm understanding of basic differences.

Man on earth has only a definite, allocated life span. He can, in effect, increase his years by increasing the time he has for himself. This gain comes from countless corollary effects stemming from the initial basic change in land communications.

So important is this prime factor for universal peace and prosperity that the Food and Agriculture Organization housed the IRF congress in its Rome headquarters. The Pope in a special audience to the convention made a fifteen minute statement stressing the vital importance of good roads to world social development and harmonious understanding. The Mayor of Rome in his opening remarks added the historical note on the auspicious choice of Rome for this meeting. Since antiquity all roads lead from Rome—for the purpose of maintaining the military might of the Empire. (This is why the Romans withstood the centuries and why Alexander's empire crumbled with his death.) Now world roads hold the network of world peace.

With world industrial money in action for peaceful and mutually beneficial purposes in a non-political vein, only more good can come of this whole venture which has prospered so well during the last seven years. What about the IRF? What is this force that gets things done?

The International Road Federation is a child born of American abundance and world need. It was conceived before the war to aid areas in which communication activity was dormant, but it never became a working fact until May of 1948. Business and industrial leaders thought of a mutual benefit program whereby social and economic conditions could be improved in the less prosperous areas while at the same time their own sales would be increased while promoting good will.

Field representatives of these companies would interest a number of enterprising local business people in forming a National Better Roads Organization in that individual country. The only requisite for membership in the International Federation is that the local organization be dedicated and non-political. In this way nations would in-

Along new border to border highway stretching from El Paso, Texas, to the Guatemalan frontier.

Cali-Medellin Highway, Colombia

vest in the construction and maintenance of a highway program in their own country, built by local forces on local capital, with some United States assistance where needed. American equipment and material would move and the companies would provide the best in that specialty's technical advisers.

This movement prospered. At the same time the Washington office opened, one also opened in London. Now there are three central offices: Washington for the Western Hemisphere and Pacific Islands; London for the British Commonwealth, Africa and Asia; and Paris for all Europe. These offices merely act as advisory and control centers. The actual promotion work is done in the countries themselves by National Better Roads associations. There are 60 of these autonomous self-supporting associations in 57 countries. They sent a total of some one thousand delegates to the Rome meeting.

Financing of the three central offices (which are independent of each other) and their monthly bulletin "World Roads," as well as the quarterly magazine, "Road International," is by contribution from supporting industries in Britain, France, and the United States. Time is money to these people so that action and results are fairly well guaranteed. Some of these companies in the United States are: Automobile Manufacturers Association, Caltex Oil Company, Ltd., Construction Industry Manufacturers Association, Ford International, Edwards Kelcey and Beck, General Drafting Company, Inc., General Tire and Rubber, Goodyear Tire and Rubber, International B. F. Goodrich, Minnesota Mining and Manufacturing Company, Prismo Safety, Shell Oil, Socony-Mobil Oil, Soiltest, Inc., Standard Oil of New Jersey, Standard Vacuum Oil, Thompson-Cornwall, Inc., and U.S. Rubber Company.

What are some of these social and economic aspects? The FAO, charged with feeding the world adequately, pleads that a major part of the richer agricultural areas could provide abundant foodstuffs if there were enough farm-to-market roads to get them out. The development of the now principal dairy industry in New Zealand is due solely to the accessibility of such areas via new roads. Since the existence of its basic road network, Ecuador annually exports $560 million in bananas—as against zero before.

The natural resources of the earth must be moved to where they can be processed and the results must get to the customer with the least amount of lost time and overhead cost. Here roads are a most vital contributing factor. Today's roads fail to measure up to the needs of an expanding world economy. This means a sterilization of wealth that even the richest countries can ill afford. Man has succeeded in flying at 1200 mph; yet in moving people to-and-from work at peak hours, a London bus today travels slower than its horse-drawn ancestor.

Imagine, say, six thousand ve-

About the Author

M. D. Morris

Mr. Morris received his B.C.E. degree from Cornell in 1944, and was active in A.S.C.E. and varsity football as an undergraduate.

Since graduation, Mr. Morris' work has taken him into such varied fields and problems as: trouble shooting on Curtiss-Wright Army transport planes; building sanitary works; lab surveys in Trule, Greenland; constructing farm-to-market roads in Venezuela; and making the Master bill of Materials for U.S. Steel's Orinoco Mining Project.

At present he is a contributing editor to McGraw-Hill International, chairman of the Committee on Publications for the Construction Division of A.S.C.E., and a member of soils committee of A.S.F. M. He is also active in the U.S. National Council on Soil Mechanics and Foundation Engineering, the Concrete Industries Board of N.Y., Cornell Society of Engineers, and International Road Federation.

hicles a day on a normally travelled road (or about four cars each minute past a given point). Just one minute's delay each day in this stream has been calculated to cost $19,000 a year.

World vehicle production in 1938 was some 42 million annually. Today it stands at 84 million per annum on roads that were already inadequate 20 years ago. By 1965 the United States might expect to strangle on 85 million vehicles. Stretched out bumper to bumper they'd make a single line around the Equator or a line an eight-lane coast - to - coast U. S. highway couldn't hold.

In the U.S. every year traffic fatalities exceed the entire population of Boise, Idaho, and injuries equal the combined population totals of Cleveland, Ohio, and Dearborn, Michigan. This carnage costs $4.5 billion a year, while the year's tab for road deterioration is another $5 billion. An integrated and adequate highway system in the United States would save 3,500 lives a year —this is proportionately comparable for the rest of the world.

A European study on vehicles travelling a given 100 mile stretch of old highway and on an equal piece of modern highway reveals the following: per mile of road per year, gear changes were five against 450; brake applications, 4 to 500; and steering wheel movements of more than two inches were one to 300—all in favor of the new road. This posed a further question of safety: a driver has a tendency to become drowsy and to falter from the monotony of the long straight road. This, however, is a matter of self-discipline for the individual since curving the right of way diminishes the economic feature, and providing suitable entertainment is an unsafe distraction.

The U.K. delegation resolved that we lower the cost of living by planning highways to accommodate us 20 years hence. The delegate from Peru moved that we hasten to complete the 30,000 kilometer Pan American Highway system by closing the last 1000 km. gap through Darien, Panama. (This is an all American function under the independent Pan American Highway Congress and backed by the Organization of American States.) A resolution was passed to cut the red tape involved and expedite the crossing of frontiers; another resolved to provide adequate town planning for roads and streets passing through settled areas.

We do not "spend" money on roads; we invest it against a profitable expected return. We pay for good roads whether we have them or not—but we pay more without them.

From whence is this money to come? The question of financing evoked a considerable difference of opinion. Local sources were acknowledged but highway moneys were probably to come from national and international levels and from private means—tolls. Who pays for the roads? The answer is everybody because roads are a source of general benefit to all.

Usually taxes on gasoline and oil, automotive parts, and vehicles themselves (original sales and later licensing fees) provide the income source for road construction and maintenance. In England £450 million a year in automotive taxes come into the general coffers, of which only one fifth goes to roads.

Road construction east of Caracas, Venezuela. When it is completed, road will run through developing Cocoa region which has been suffering from lack of adequate road communication.

Puerto Rio Viejo-Nicaragua, four span timber bridge (1943-1952).

Puerto Rio Viejo-Nicaragua, reconstructed bridge on old piers by Nicaraguan Highway Department with cooperative funds from Nicaragua and the United States.

The entire assembly berated the practice of diversion of highway tax funds into other channels while that program operated at a minimum. The Pope, in his address, expressed the hope that all moneys earmarked for road work would find their way to that end alone.

The Australian delegate suggested that by anticipating a network plan some 10 to 20 years in advance, planners could save much real estate costs by buying land before the values rose. Then he offered the resolution not to divert road revenue money to any other outlet because motor source taxes (always a sure thing) have been a public milking cow for too long. Southern Rhodesia thought we should look for new sources of income and suggested a land tax on the ground that a road increases land values.

Almost unanimously the toll road was deplored for world areas, it being desirable that road financing should come neither from tolls nor loans, but from tax boxes alone. This is not at all applicable for the United States where, during the last five years, toll-supported autonomous state authorities have worked a minor miracle in a network of turnpikes or toll roads, which are a thing apart from the regular State and Federally financed highway programs.

The United States has loaned or granted sums of money to many less prosperous areas for basic road programs. This aid is for the farm-to-market road and not for the super highway. To insure proper allocation of these funds and to keep the local expenders well advised, the United States International Cooperation Administration has a full time highway engineer, Mr. A. J. Van Dyke, whose job it is to go around the world and supervise this program.

A resolution was offered to increase taxation on fuel, tires, etc. and eliminate all other forms, so that only the users of the road would pay and then, only in proportion to the amount they actually used the roads. This move was urged down by the British because it would be injurious to the manufacturer of the over-taxed items. It was expressed that the IRF would be ill-advised to tell individual countries how to handle their own finances.

Regardless of how funds are derived, in order to insure the best value received per road coin expended, all dealings must be in terms of experts and specialists. They have the actual experience and thorough technical training.

Who should these men be? And what sort of training should they have?

To keep our highways alive and successful, technical training in all phases is being given to apt pupils globally and locally. The technical needs are for: civil engineers to select new locations, design new highways, and improve the old; specialists in air-photo analysis to save many months of on the ground reconnaisance; soils engineers to determine the correct subgrades and drainage to keep the road from crumbling; town planners; geologists for tunnels; bridge designers; research men to find and develop the best type of pavements—concrete, asphalt, and more recently, the topsoil itself made stable by chemical injection. This is only the first phase.

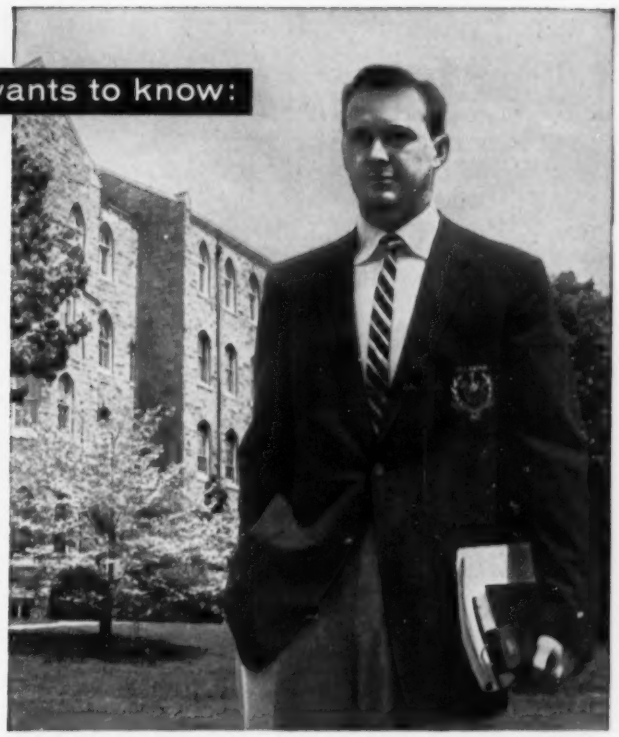
Maintenance men adept at both right-of-way and vehicles, keep the wheels rolling. While traffic engineers solve congestion, economists work out program plans, and financiers make them work. Lawyers, physicians, and sociologists cope with the human element; and administrators tie it all together.

While all these people keep the stream moving, it should be pointed out that safety education is of prime importance. The proper training of drivers in all categories

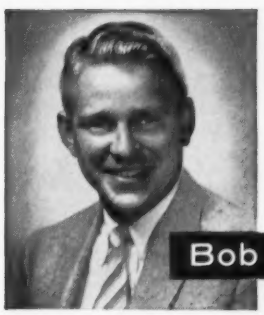
(Continued on page 60)

John Nettleton wants to know:

How would a graduate degree affect my chances for advancement at Du Pont?



John C. Nettleton expects to receive his B.S. in chemical engineering from Villanova University in June 1957. He has served as president of the student chapter of A.I.Ch.E., and as secretary of Phi Kappa Phi fraternity. John is now wondering about the pros and cons of advanced study in his field.



Bob Buch answers:

Robert J. Buch, M.S., Ch.E., came to the Engineering Development Section of Du Pont's Grasselli Research Division from the University of Louisville four years ago. Since then, he has engaged in many kinds of chemical engineering work, from pilot-plant operation to evaluation of the potential of proposed research programs. Within the last year, Bob has taken the responsibility of procuring B.S., M.S., and Ph.D. technical graduates in all phases of chemistry and chemical engineering for the Grasselli Research Division.

AN advanced degree would undoubtedly have a *favorable* effect in technical work, John, but let me enlarge on that just a little. In your own field (and mine, too) a higher degree is considered to be evidence of ability in carrying out original research. It is therefore helpful in obtaining work in research and development, where that skill is definitely important. You might say that it gives a man a head start in proving his ability in those areas.

It's less important in some other areas, though. For example, in production or sales work ability for handling human relationships is just as important for advancement as technical competence. If an engineer is sold on production work or sales, a graduate degree in marketing or business administration might be more helpful to him than advanced technical training in getting started.

But I've noticed this at Du Pont. Once a man lands a job in his chosen field and actually begins to work, his subsequent advancement depends more on demonstrated ability than on college degrees. That's true throughout the entire company—in scientific work, administration, or what not.

So an advanced degree is not a royal road to anything at Du Pont, John. But when coupled with proven abilities, it is unquestionably helpful to a man in research and development work. It often gets him off to a faster start.

Are you interested in research work?

About 2,000 Du Pont scientists are currently engaged in research, aided by some 3,500 other employees. Laboratory facilities of the highest quality are available at the Du Pont Experimental Station near Wilmington, and elsewhere throughout the country. Information about research at Du Pont is given in "Du Pont Research." Write for your copy of this free 28-page booklet to the Du Pont Company, 2521 Nemours Building, Wilmington, Delaware.

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The result? Welding of the Nautilus hull was accomplished in record-breaking time — and cost less than originally estimated. Unchanged, the Worthington roll set-up is also being used in the construction of the nation's second atomic sub, the USS Sea Wolf.

Turning rolls for submarines aren't all that Worthington makes. The long list of Worthington-designed, Worthington-built equipment includes air conditioning units, construction machinery, compressors, Diesel engines, steam power equipment and, of course, pumps of all kinds. For the complete story of how you can fit into the Worthington picture, write F. F. Thompson, Manager, Personnel and Training, Worthington Corporation, Harrison, New Jersey. You may be glad you did.

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Faculty Profile

Dr. F. H. "Dusty" Rhodes

by Frank Walsh, ChemE '59

Few people in their life's time have had the satisfaction of having made the original plans for a school, carried through and developed these plans in that school, and seeing that school attain a top-ranking position in its field. Such has been the work of Dr. Fred H. Rhodes, Director of the School of Chemical and Metallurgical Engineering at Cornell University.

Dr. Rhodes was born in the small mid-western town of Rochester, Indiana, on June 30, 1889. He attended Rochester High School and Wabash College, at Crawfordsville, Indiana. After graduating from Wabash College, in 1910, he entered Cornell as graduate student and Assistant in Chemistry. As Assistant, he taught for a time in laboratory courses in Qualitative and Quantitative Analysis and, later, was special research assistant to Professor L. M. Dennis, Head of the Department. He received the degree of Doctor of Philosophy in June, 1914.

In September, 1914, he was appointed Instructor in Chemistry at the University of Montana at Missoula. While at the University, and during the following summer, he was consultant for the Anaconda Copper Company on the flotation of copper ores and on the recovery of zinc from the newly developed zinc ores at Butte. Among his students during the year at Montana were Lansing Wells, later head of the Cement Division of the U.S. Bureau of Standards, and Harold Urey, later internationally known authority on atomic physics.

In September, 1915, Dr. Rhodes returned to Cornell as Instructor in Qualitative Analysis. During his first year as instructor, Morse Hall, which housed the Department of Chemistry, burned. To accommodate those students for whom qualitative analysis was a required course, a small laboratory was established in a room on the top floor of the then new Stocking Hall. The new laboratory looked very neat and very efficient and sanitary, with its fresh coat of nice, white paint—white lead paint. After the first day of exposure to hydrogen sulphide, the paint turned streaked and dirty gray; after the second day, it was black. At the end of the term, the work in qualitative analysis was transferred to the attic of Rockefeller Hall. This was a large bare room directly under the slate roof. It wasn't ideally suited to the purpose. In summer, the ether in the bottles boiled to the merry tinkling of the glass stoppers; in winter, the reagent solutions froze and the ink in the fountain pens congealed. There was little ventilation; through the big room, clouds of white fume swirled and the stench of hydrogen sulphide hung heavy.

Dr. F. H. Rhodes

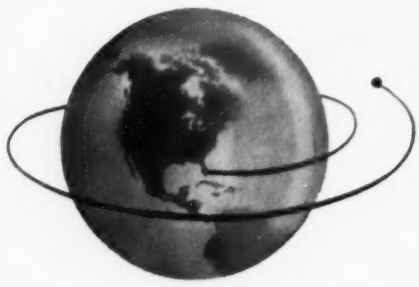
While he was instructor at Cornell, Dr. Rhodes was employed as consultant by the Barrett Company and worked on the development of a process for the manufacture of synthetic phenol. The First World War had begun in Europe, although America had not yet entered the conflict. Phenol was urgently needed as a basic material for explosives and for many other purposes. In Professor Rhodes' own words: "I didn't know anything about making phenol; in that respect, I was the equal of the best chemical engineer in the country." The process was worked out in a little room in the basement of the somewhat repaired Morse Hall; the equipment consisted of an iron pot, a rusty two-burner gas plate, and some beakers and flasks. On the basis of some pretty sketchy experimental data and of some pretty rough and ready calculations, the plant was built as a unit of the Frankford, Pennsylvania, Plant of the Barrett Company. As Dr. Rhodes admits: "It was a terrible plant. About everything that could be wrong *was* wrong—but it made phenol, and it made phenol cheaper than any other plant in the country. I later had the opportunity, or the obligation, to operate the plant. I have often expressed very uncomplimentary opinions of the stupid engineer that developed it."

In 1917, Dr. Rhodes went with the Barrett Company, at Frankford, as research chemist and, later, as Director of Research for the Chemical Department. His first assignment was to develop a process for making alizarin dye, or "Turkey red," from anthracene. Other projects included improving the processes for the purification of naphthalene, anthracene, carbazol, and

(Continued on page 65)

Honeywell...*from thermostats to inertial guidance for satellites...*

Two of Honeywell's 12,000 different automatic controls are the Honeywell Round—first entirely new thermostat design in 70 years—and an ultra-sensitive type of inertial guidance system, which will direct the rocket placing the world's first man-made satellite in its orbit.



Over thirty years ago in the *American Mercury* the inimitable journalist H. L. Mencken wrote, "Of all the great inventions of modern times, the thermostat has given me most comfort and joy. Not for a dozen Marconis, a regiment of Bells, or a whole corps of Edisons would I swap the great benefactor of humanity who invented the incomparable thermostat."

Honeywell began in a basement, with the invention of a simple bimetallic thermostat to open furnace dampers on chilly mornings. But extensive research into electricity and electronics, pneumatics, gases, metallurgy, chemistry, plastics, and plain and fancy physics has diversified Honeywell by means of engineering and new-product development into *automatic control for almost every known purpose.*

EXCITING GROWTH: Today, after 72 years, Honeywell has grown and is growing still—the world's leading designer and manufacturer of all kinds of automatic controls. Sales have more than doubled every five years. In the *last 7 exciting years alone* Honeywell has increased sales more than fourfold—from $57 million in 1948 to $244 million in 1955. In these 7 years over 20,000 new employees from all over America have joined Honeywell to find new opportunities. Honeywell now has 31 factories and 160 sales and service offices throughout the world.

MAIN FIELDS: Basically, Honeywell operates in three main fields: heating and air conditioning, industrial instrumentation, and aeronautical controls and ordnance equipment. But the common denominator is always *automatic control.* Heat, color, density, liquid level, humidity, weight, or any other measurable factor—such as attitude deviations of planes or missiles in flight—can all be recorded and controlled.

REMARKABLE DIVERSITY OF PRODUCTS: More than 12,000 *different* Honeywell products give you an idea of the range within which you can build a highly rewarding career. Because Honeywell is operating in almost all the fields known as growth industries, our continuing drive to provide new markets, new products, and new systems promises you a rewarding future.

SMALL UNITS MEAN OPPORTUNITIES FOR YOU: Our employees operate primarily through *personal contacts* with supervisors and fellow workers. Our small units present multiple opportunities for early managerial experience as (1) project leaders, (2) section heads, (3) foremen, (4) department heads, (5) chief engineers, or (6) sales managers. As Honeywell continues to grow, advanced positions are filled largely by men who have worked up from within. So, as an employee, you too will have real opportunities to fill Honeywell's future managerial needs. And Honeywell needs restless men who can accept and discharge responsibilities.

SCIENTIFIC MANAGEMENT: The men who run Honeywell are a top management-science team. Year after year the American Institute of Management has rated Honeywell "excellent"—the top rating among America's best-managed companies. Honeywell's management recognizes that our growth in the challenging future depends in the largest measure upon the initiative, intelligence, and interest of the young people now starting with us.

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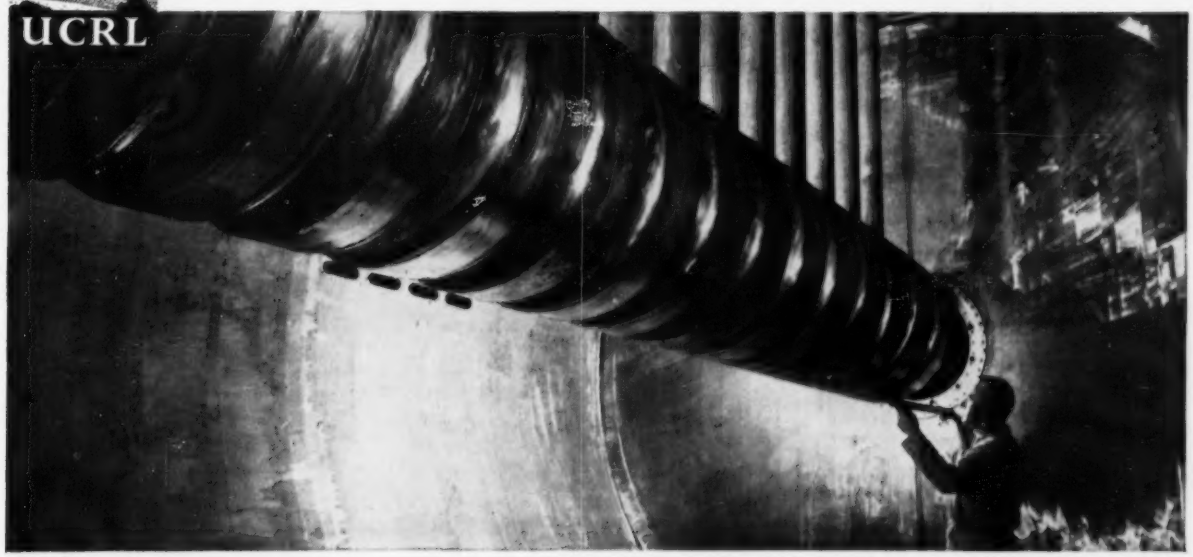

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THE HIGH FIDELITY RECORD

by

Bruce Augustus, ME '59

In the days of Edison and Bell, records were wax cylinders or discs which were played on handcrank-operated machines. Recording was achieved by talking directly into the large end of a megaphone-type horn. At the small end of the horn was placed a diaphragm, to which a cutting needle was rigidly attached. As the wax record was turned the vibrating needle cut grooves into its surface in accordance with the sound that was directed into the horn. This purely mechanical means of trapping sound is known as acoustical recording. Reproduction was achieved in the same manner except that a round-tip playback needle was used instead of the sharp cutting needle.

The first steps toward the electrical recording techniques used today were taken in 1927, when carbon, magnetic and capacity-type pickup cartridges were introduced. These advantages were, of course, forestalled until the development of the radio, microphone, and vacuum-tube amplifier, but did appear shortly thereafter. The results of these innovations were immediate. Most of the harmonics and overtones, and even some of the fundamental notes were lost in the early acoustical recording; but the electrically operated cutting stylus and pickup, coupled with the microphone amplifier reproduced a far wider range of notes with considerably less distortion. This was the real beginning of high-fidelity recording.

The Cutting of Records

In today's recording techniques, the magnetic cutting head is used almost exclusively. When a magnetic head is used to cut a disc at constant groove speed, it provides for a flat frequency response if the disc is played back at constant hub speed. This sentence may, at first glance, seem rather formidable, but will become quite clear after a few terms are defined.

There are two popular methods of lateral disc recording: constant groove speed and constant hub speed. The name of the latter is self explanatory and the former is by far the most widely used, so only the former will be discussed in any detail. Using the constant groove speed method, the turntable speed is varied in order to maintain the linear velocity of the groove being cut at 12 feet per second, as opposed to 48 fps at the circumference and 12 fps at the innermost groove using constant hub speed.

A magnetic cutter operates according to the principle that its speed of movement is proportional to the magnitude of the voltage applied to it and its sideways displacement is inversly proportional to the frequency of the applied voltage. This method of recording is also known as the *constant velocity* method because of the characteris-

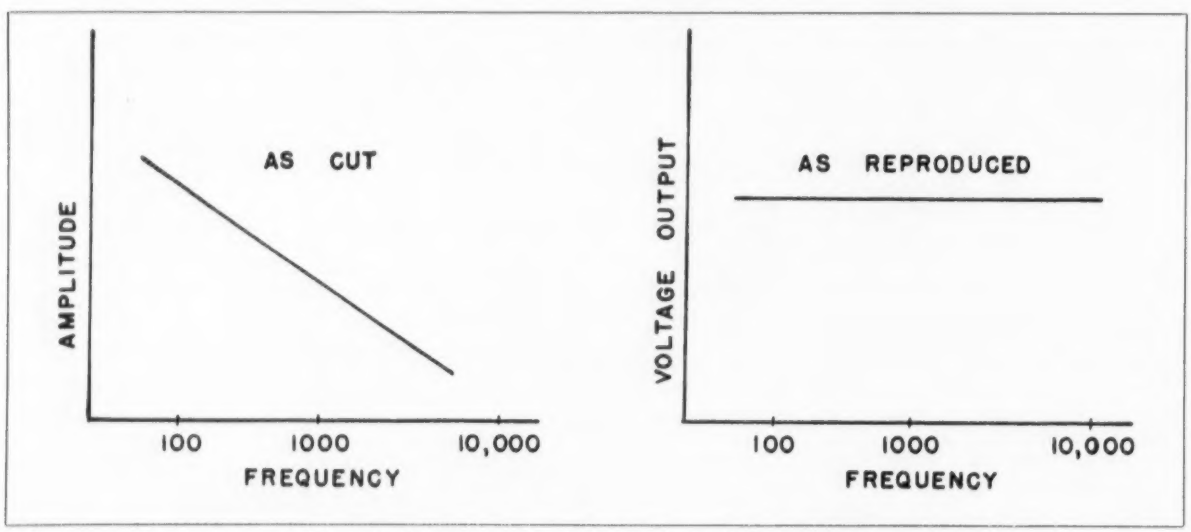

Figure 1. Frequency response for "constant velocity" recording.

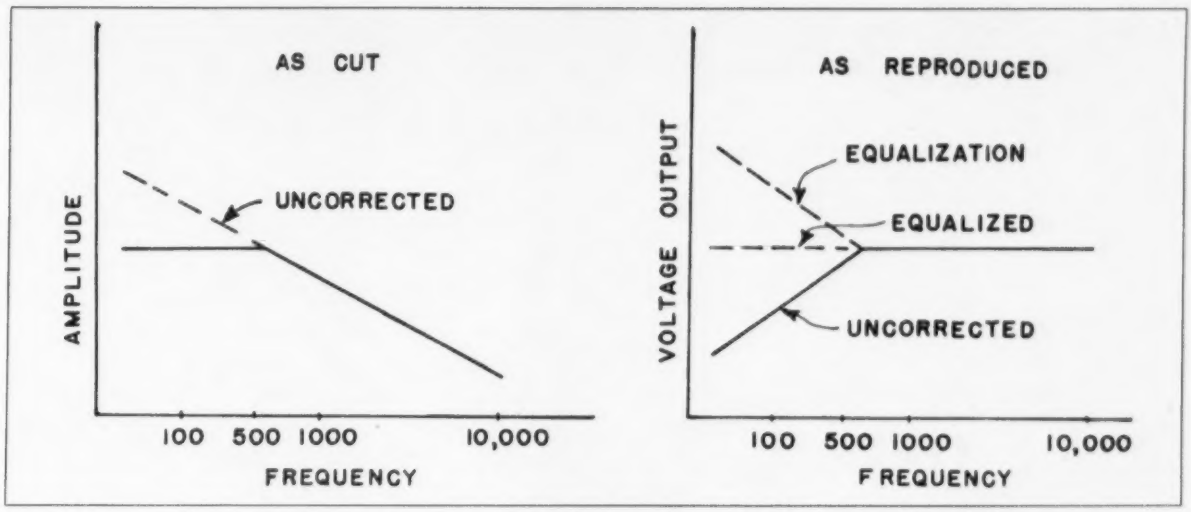

Figure 2. Base turnover is process of attenuating lower frequencies in order to avoid overcutting.

tics of the cutter which maintain a constant stylus speed, regardless of amplitude or frequency. This observation may be verified by application of the basic physics formula:

$$V = f \times a$$

or velocity of the cutter is equal to the frequency of the applied audio voltage multiplied by the amplitude of the groove cut into the record.

This may seem at first to be a rather inconsequential observation, but further scrutiny shows it to be a crucial relationship. It states that for every increasing octave, the physical size of the recorded amplitude (fig. 1.) is halved. This implies an upper limit to recorded frequency set by the minimum recorded amplitude that will be distinguishable from surface noise. It may also be inferred that a lower frequency limit also exists by nature of how close the grooves are to each other. Is it not then conceivable that these two limitations could drastically hinder the progress of high fidelity recording? This was, in fact, the case until the problem was finally solved by what is commonly known today as equalization.

Equalization

The first problem to be dealt with was overcutting. If we assume 100 grooves to the inch the groove centers are .010 inch apart. This means that the cutter may not exceed .005 inch of travel on either side of the groove center, for if the tone persists throughout arc revolution, the adjacent grooves will cross. Using the equation mentioned previously

$$V = f \times a$$
$$3 = f \times .010$$
$$f = 300 \text{ cycles/sec}$$

it is seen that no frequencies below 300 cps may be recorded. The solution to this problem is illustrated graphically in figure 2 and is achieved through an attenuation of six decibels per octave of all frequencies below 500 cycles.[1] This means that all tones below 500 cps are recorded with equal amplitude. (An attenuation of 6db per octave results in halving of the amplitude for each lower octave. Recalling fig. 1, this creates equal amplitudes regardless of frequency.) The name given to this process is *base turnover* and 500 cps is known as the *turnover frequency*. Of course some compensation must be incorporated into the playback equipment in order to retain the flat response which was originally desired. This compensation is simply a bass boost of 6 db per octave below 500 cps.

In the treble range, at or near 2000 cps, problems begin to arise. In this range the amplitude of the surface noise begins to approach the amplitude of the recorded material. At higher frequencies the problem is still more severe, because the level of the noise rises above the program material, making it useless to try to record. This is overcome by giving a gradual treble boost (pre-emphasis) to the recorded material. At playback, of course, the treble must be attenuated by the same amount in order to maintain balance. This is called *treble rolloff* and is shown graphically in fig. 3.

When rolloff and turnover are combined, the result looks like fig. 4. A flat frequency response has been achieved.

It must be understood at this point that the figures and specifications mentioned must not be assumed universal. Each record company uses the recording characteristics that it considers best; and although the figures quoted are a representative example of the many similar methods used, there is no single standard. Due to this lack of uniformity, amplifier and equalizer manufacturers are compelled to incorporate four or six different positions of compensation into their units. As a result of these capricious methods of manufacture, the audiophile is confronted with a hodge-podge of equalization charts, record labels, knobs and settings on preamplifiers, and a host of other annoyances, which invariably cost money and produce more confusion than results. The chaos has been somewhat alleviated by the standardization of a few of the various schemes. The NARTB (Nat'l Ass'n of Radio and TV broadcasters, formerly NAB) set up an equalization curve which was accepted as satisfactory and adopted by the AES (Audio Engineering Society) and RIAR (Record Industry Ass'n of America).

[1] 500 is chosen instead of 300 in order to provide a safety factor.

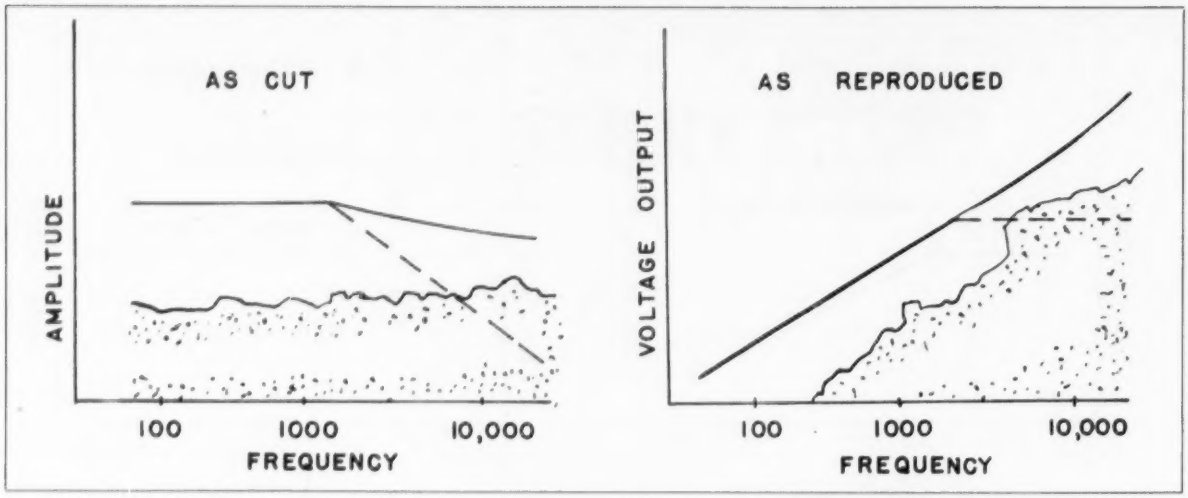

Figure 3. Turnover is the process of boosting treble range in order to transcend surface noise.

Since most records were recorded according to one of these three curves, much was accomplished by this move. Although there are still some obstinate independents, the differences in characteristics are, in most cases, small enough to be overlooked.

The Manufacture of Records

In the few years since microgroove recording has come into its own, record manufacturers have managed quite well to keep abreast of technological advances in recording. Because microgroove recording employs finer groove spacing and vinylite discs, many advantages over standard transcriptions result: longer playing time, greater range of frequency response, light stylus pressures and a relative absence of needle scratch.

With a narrower groove of .0023 inches, 200-300 lines per inch may be obtained. Needless to say, dimensional tolerances are difficult to hold to a minimum in order to obtain excellent sounding records.

Records are first cut in the sound studio by a sapphire, alloy, or steel cutting stylus. Steel styli have a useful life of about 30 minutes and cannot be resharpened. Sapphires, due to their quality of sharpenability, give many hours of useful service and are by far the most widely used. Only one record is actually cut in the studio. This record is called the "master," and from it many duplications are made. The master is a metal disc, coated with soft lacquer, into which the grooves are cut. Recently the work of the cutting stylus has been reduced from cutting and modulating a groove to just modulating it. This has been achieved by using pregrooved blanks. Of course, the stylus still must remove some lacquer, but the amount is greatly diminished.

Having completed cutting and inspecting a "master," the recording engineer sends it to the processing plant, where a number of metal reproductions are made from it. The "master" is first sensitized in a stannous chloride solution and then silver plated by a chemical solution in order to make it a good electrical conductor. A film of copper can now be electroplated on the silvered surface. After .032 inch has been plated on, the copper negative is removed from the "master."

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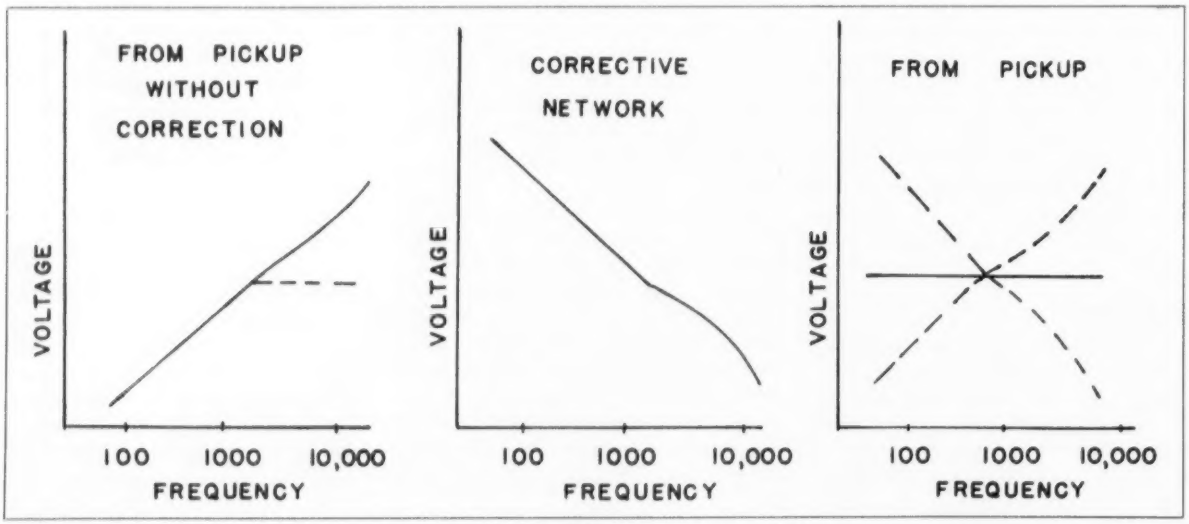
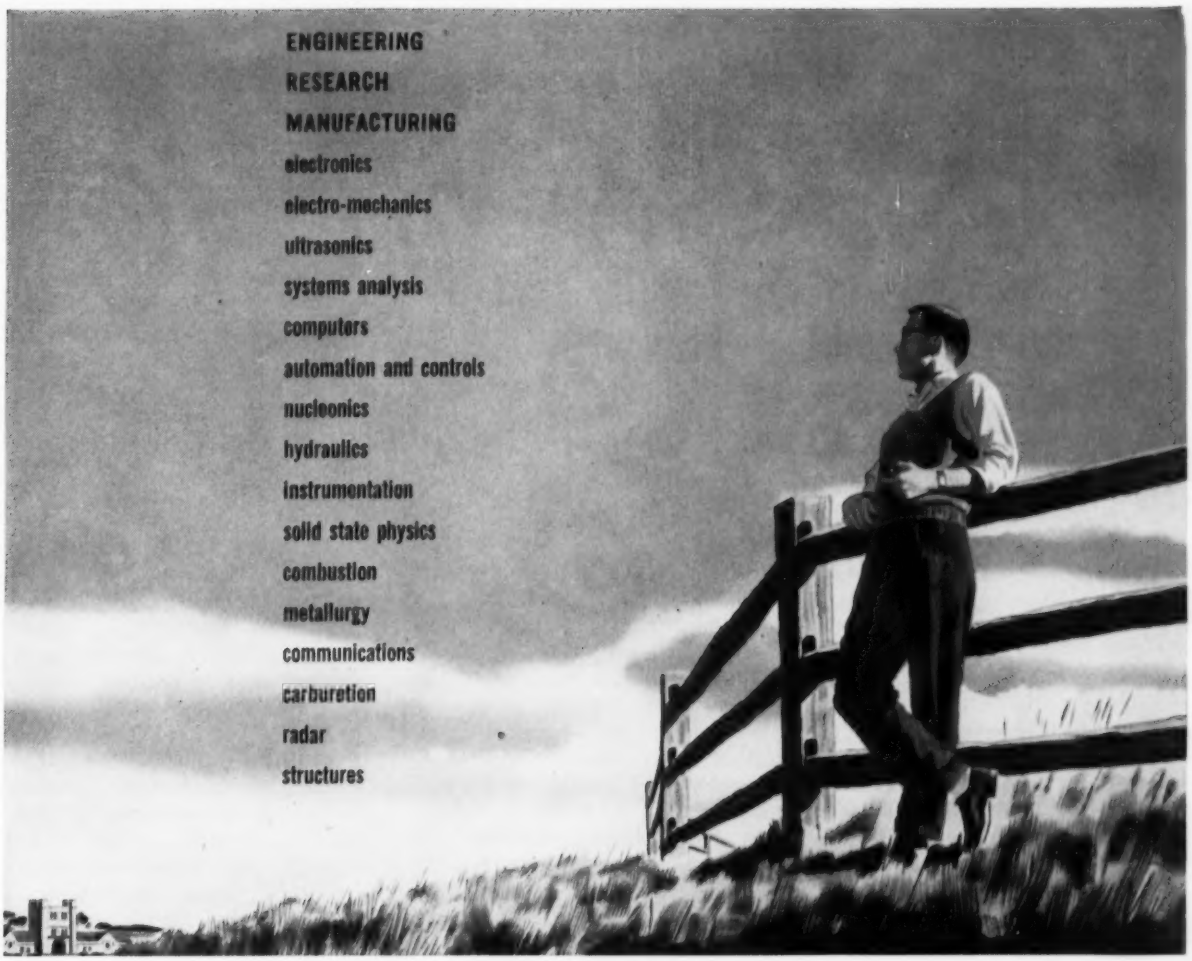


Figure 4. The combination of rolloff and turnover produces a flat frequency response.



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SOIL TESTING

by

J. H. McMinn, B.C.E. '44, M.C.E. '47

The science of soil mechanics and foundation engineering has developed rapidly in recent years and continued growth can be expected. Much of the appeal of this field, aside from the natural desire in some of us to work close to the soil, lies in this indeterminate growth potential. Many phases of civil engineering (of which soils engineering is a branch) have been quite thoroughly explored, civil engineering being the oldest of the fields of engineering study. New developments in most phases of civil engineering are rather infrequent and are arrived at rather laboriously. Much of the knowledge is "handbooked." Even when new ideas and developments do take place they are slow to receive acceptance simply due to the inertia of overcoming accepted practice.

Soils engineering by contrast is a young idea. Prior to the 1920's when Karl Terzaghi, the "founder and guiding spirit of soil mechanics," published his early papers and even for a decade after, soils engineering was more of an art than a science—an art which could best be described as "poke around and jump up and down." Of course some work had been done in the 1800's by such men as Boussinesq, Coulomb and Rankine which had definite applications in the science of soil mechanics, but acceptance, application and development of these men's work has only come in recent years as our empirical knowledge grew.

Prior to the Second World War there were very few consulting engineering firms in the United States which dealt strictly with soils engineering. Even today their number is relatively small. It is a matter of educating clients (architects, engineers, contractors and owners) to the value of soils engineering and this is only possible through the development of an experience background against which to test theory. Soils engineering must—like any other branch of engineering—pay its own way and do it in a manner that can be proven by economics. The old adage about an engineer being "a person who can do for one dollar what any damn fool can do for two" is especially applicable to foundation engineering, since foundations must be reduced to terms of pure utility and can seldom excuse any part of their cost under the guise of aesthetics.

Soil Testing Services, Inc.

Field party performing CBR test on compacted sandy test fill. Data obtained were used for design of paving on airfield runway.

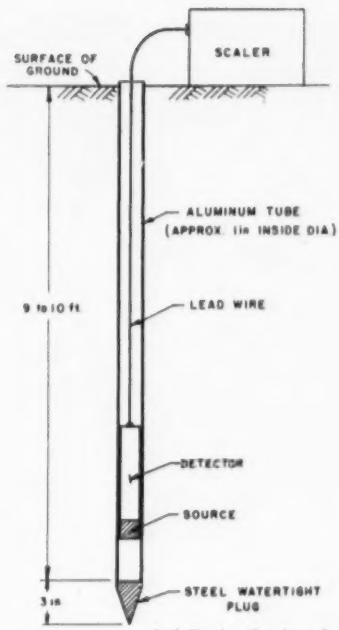
The organization and growth of soils engineering firms has been quite rapid in the past decade. This growth stems largely from the accelerated growth of soil mechanics programs in our educational institutions prior to and during World War II along with increased interest in the field during and since the War from the standpoint of both private industry and governmental agencies. The Corps of Engineers has been an important factor in this growth due to problems arising out of airfield construction and flood control projects. Federal and state road building programs have also shared in this growth.

From the standpoint of the private consultant or commercial laboratory, the greatest single factor has probably been industrial growth and expansion during the past decade. Almost any large metropolitan area is likely to have at least one soils engineering consultant and areas in which growth has been particularly large and especially in those areas where marginal land has had to be developed—the company or individual seeking soils engineering services is likely to have not only a variety of firms to choose from, but the various firms may each offer a slightly different approach to the problem. It should

be inserted here that the development of marginal land would be at best hazardous and at worst impossible without soils engineering as we know it today. Even with proper soils engineering the predicted results in particularly difficult situations will always carry some qualification.

On projects where the results are somewhat less than perfect, the deficiencies can usually be related to the heterogeneous nature of the material with which soils engineers work. Like timber engineers, soils engineers work with a product of nature. Soils, both as to deposition and composition, are the product of all the forces of nature. Its properties can either be accepted, altered by various means (drainage, chemical injection and compaction to name a few) or ignored (that is loads can be transferred through undesirable strata by piles or piers or the material can be excavated and replaced with suitable material).

This heterogeneous nature of the material, not only locally but also geographically, makes progress in the field difficult—and in fact accounts to a large extent for the tardy development of the science.



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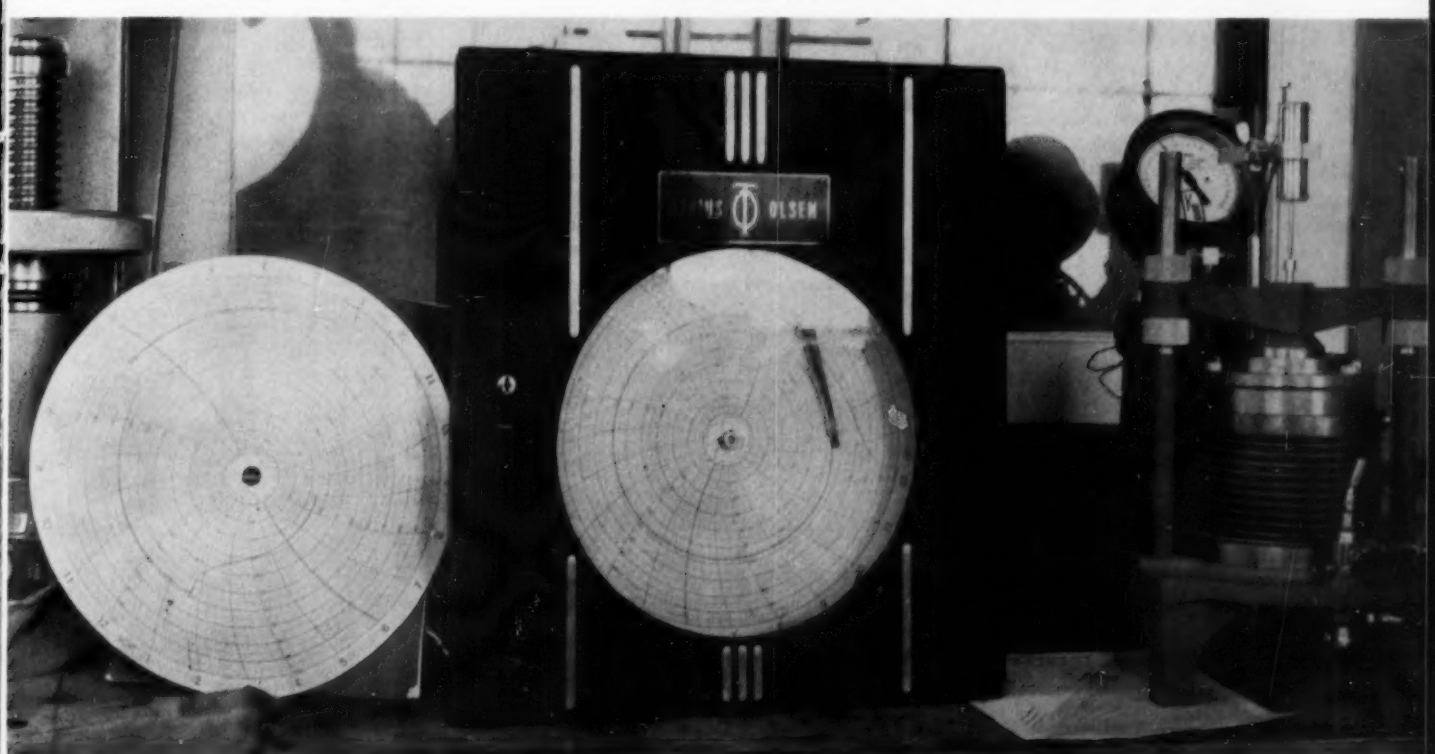
Diagramatic sketch of moisture and density measuring device using radioactive methods.

This inherent quality will always be with us and must be accepted. Classification systems have sprung from a great many sources, each suited to a particular problem or area (that is roads, airfields, agriculture, etc.). No universal classification system has been or is likely to be adopted for quite some time.

Testing procedures vary not only with the problem to which the results are to be applied (that is roads, dams, bridges, etc.) but also with the location of the testing agency—even though the basic problem is the same. By way of illustration the California Division of Highways has developed many testing procedures (CBR Test for example), some of which have been accepted and adopted by other agencies and others of which are considered to have limited application by other agencies. The problem is further compounded when some of the tests developed by one agency (again the CBR) have been discounted and abandoned by the developing agency—while the tests are still in use and considered of great value by one or more of the adopting agencies. The American Society of Testing Materials is conducting a continuing effort to standardize test procedures and their efforts are beginning to bear fruit.

The professional consultant and commercial testing laboratory (often one and the same) enter the



Tinius Olsen Testing Machine Co.

Consolidation testing machine using hydraulic load application (right above). Also shown is a recently developed electronic device for automatic recording of consolidation data (center above).

picture here. In order to make the services of these firms an economic practicability, standardization to a high degree of sampling methods, classification systems, testing procedures and engineering analytical techniques must ultimately result. If these people cannot freely exchange information and interpretations, not only within a particular area, but also throughout the world, the science will remain in its infancy. Economic considerations alone will ultimately force this standardization.

As an example of some of the interesting developments continually taking place in this field first mentioned, perhaps, should be the work conducted at Cornell in recent years on aerial photograph interpretation and analysis. Skilled interpreters with backgrounds in engineering, geology, and agronomy are now able, by means of stereoscopic observations of aerial photographs, to determine many things about the upper layers of the earth's surface. These interpretations are based on observed features of topography, tone contrast, erosion types, vegetation and drainage patterns. The resulting information has applications in engineering as well as development of natural resources, agriculture and site planning.

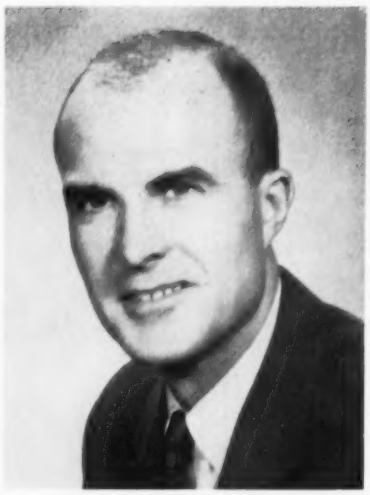
Another example is the application of geophysical exploration to foundation engineering. So far this application is mainly useful in conjunction with more conventional means of exploration—that is soil borings—and its usefulness has been limited to the definition of the transition from soils to bedrock over large areas where the cost of a complete exploration by borings alone would be prohibitive; however, new applications can be expected as geophysical exploration techniques are refined.

Another interesting development on which some work has been done at Cornell (and elsewhere) is the application of radioactive tracer techniques to the in situ moisture and density determination of soils. The method consists essentially of measuring by a counter the emission from a radioactive source along with the measurement by counter of the reflected, diminished energy after the emission has passed through the soil in situ. See figure 2. The differential indicates the amount of energy absorbed by the soil and in turn gives an accurate and rapid means of measuring the density and or the moisture content of the soil in question. Two men can operate the equipment in the field and the cost of the equipment, at least for large projects, is not excessive. It can be expected that this development will have wide acceptance on some types of projects.

An example of some of the more interesting recent developments in laboratory testing equipment is a

(Continued on page 60)

ABOUT THE AUTHOR



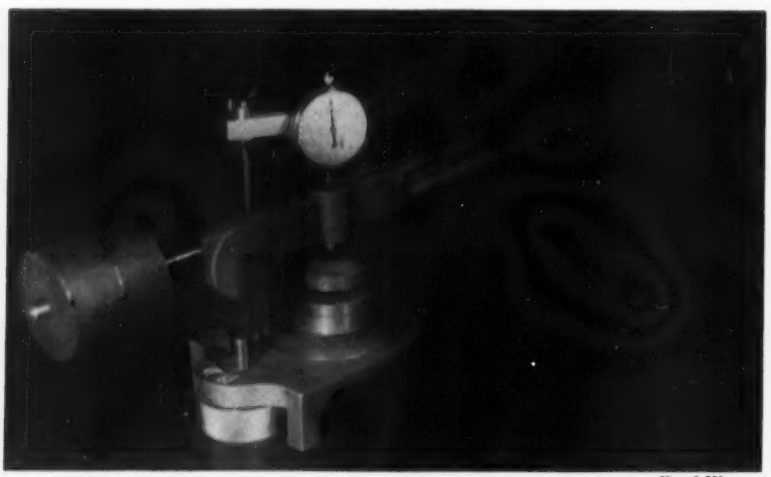
J. H. McMinn

Mr. McMinn attended Cornell University, receiving a B.C.E. degree in 1944 and a Master of Civil Engineering degree in 1947. As an undergraduate, he served as Editor-in-Chief of the CORNELL ENGINEER.

After graduation, Mr. McMinn spent three years in the general engineering department of Standard Oil Company of California. He then went on active duty with the Army Corps of engineers for two years.

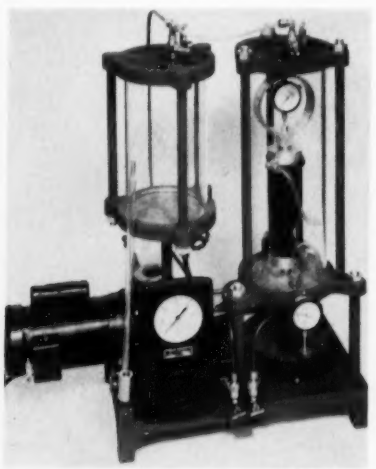
In 1955, he joined Soils Testing Services, Inc. of Chicago, Illinois. Later that year he helped found Soils Testing Services of California, the organization with which he is now associated.

Mr. McMinn's professional society membership includes A.S.C.E., Tau Beta Pi, Cornell Engineers' Club, and Structural Engineers Association of California.



Karol-Warner

Light-duty consolidation testing machine utilizing the dead weight—lever arm principle for load application.



Karol-Warner

Bench-mounted triaxial testing machine with variable speed motor for application of variable axial strain rates to soil sample.

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Now in your own home you can hear music in *perspective*, just as in the concert hall. Strings from the left. Brass from the right. The secret lies in amazing new RCA Victor Stereophonic Tape, pre-recorded with 2 sound tracks. The RCA High Fidelity Stereotape Player reproduces sound through two separated groups of speakers . . . gives recorded music new dimensions.

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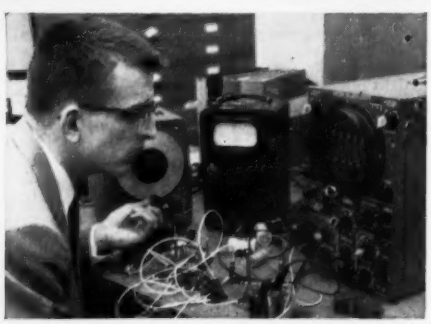
WHAT'S DOING at Pratt & Whitney Aircraft . . .



Pratt & Whitney Aircraft engineer checks a bread board model for a subminiature, encapsulated amplifier built with transistors.

A rig in one of the experimental test cells at P & W A 's Willgoos Laboratory. The six large finger-like devices are remotely controlled probe positioners used to obtain basic air flow measurements within a turbine. This is one of the techniques for obtaining scientific data vitally important to the design and development of the world's most powerful aircraft engines.

. . . in the field of INSTRUMENTATION

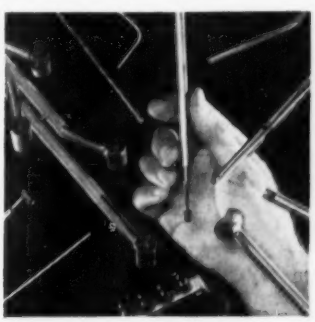
Among the many engineering problems relative to designing and developing today's tremendously powerful aircraft engines is the matter of accumulating data — much of it obtained from within the engines themselves — and recording it precisely. Such is the continuing assignment of those at Pratt & Whitney Aircraft who are working in the highly complex field of instrumentation.

Pressure, temperature, air and fuel flow, vibration — these factors must be accurately measured at many significant points. In some cases, the measuring device employed must be associated with special data-recording equipment capable of converting readings to digital values which can, in turn, be stored on punch cards or magnetic tape for data processing.

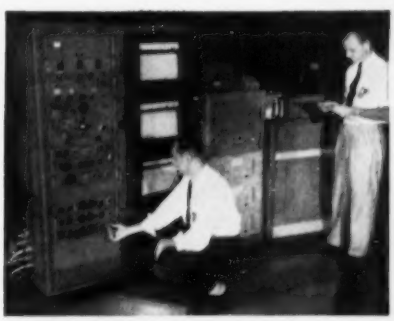
Responsible for assembling this wealth of information so vital to the entire engineering team at Pratt & Whitney Aircraft is a special group of electronic, mechanical and aeronautical engineers and physicists. Projects embrace the entire field of instrumentation. Often involved is the need for providing unique measuring devices, transducers, recorders or data-handling equipment. Hot-wire anemometry plays an important role in the drama of instrumentation, as do various types of sonic orifice probes, high temperature strain gages, transistor amplifiers, and miniaturized tape recording equipment.

Instrumentation, of course, is only one part of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program — with other far-reaching activities in the fields of combustion, materials problems, mechanical design and aerodynamics — spells out a gratifying future for many of today's engineering students.

Instrumentation engineer at Pratt & Whitney Aircraft is shown investigating modes of vibration in a blade of a single stage of a jet engine compressor.



Special-purpose probes designed and developed by P & W A engineers for sensing temperature, pressure and air flow direction at critical internal locations.



The "Plottomat", designed by P & W A instrumentation engineers, records pressure, temperature and air flow direction. It is typical of an expanding program in automatic data recording and handling.

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PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

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and
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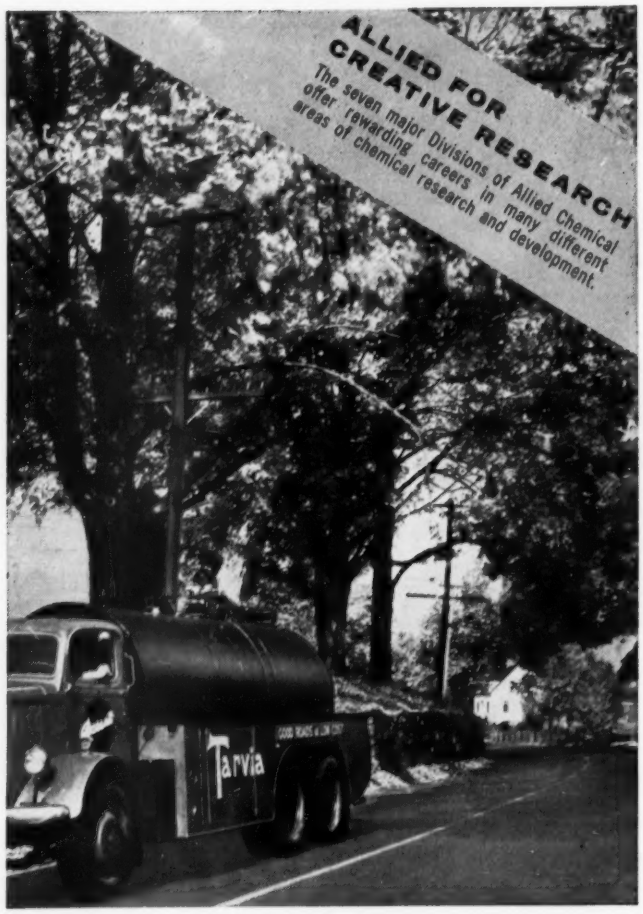
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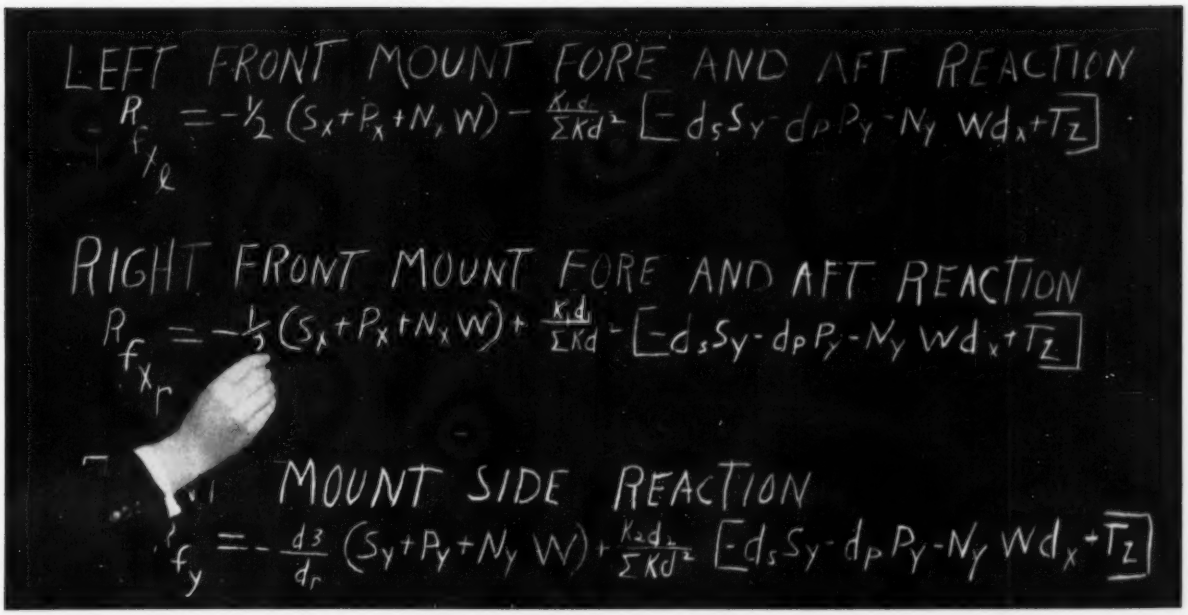

GRADUATE TRAINING AT ALLISON PICKS UP WHERE CAMPUS LEAVES OFF

WITH the completion of your academic training, you're basically qualified to start your career in engineering.

What then?

If you plan to go ahead and further your education to prepare for greater things later on you'll be interested in the Allison Training Programs.

Starting your engineering career at Allison, you are given the opportunity to continue learning while you work alongside top-level engineers in the aircraft engine industry.

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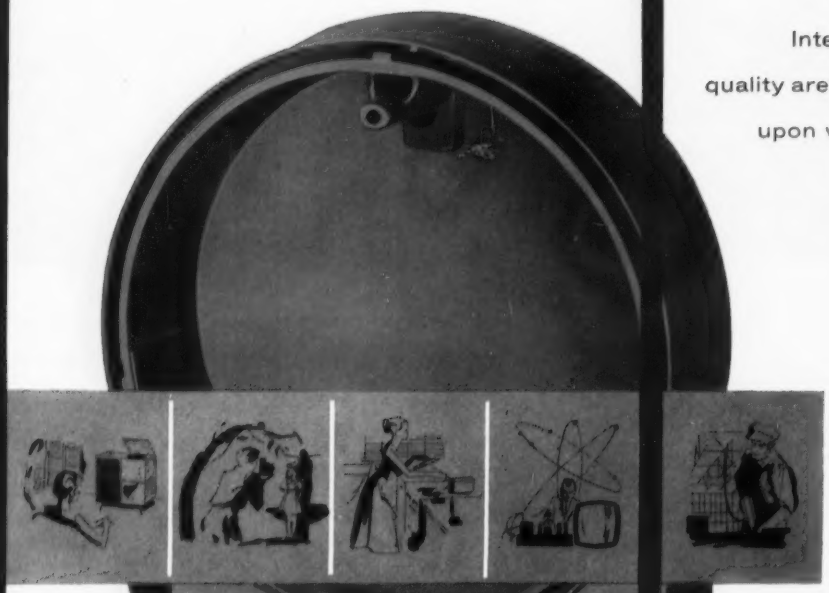
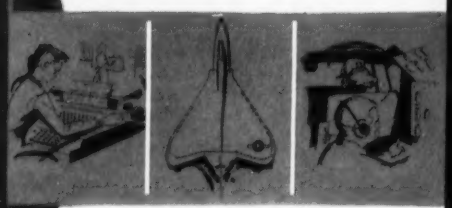
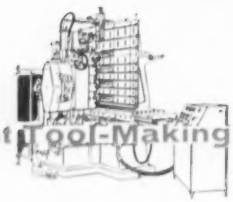


Assurance of performance in virtually all industries





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College News

NEW CE BUILDING

A Cornell University alumnus, Spencer T. Olin '21, Alton, Illinois, recently announced the gift of a new civil engineering building to his alma mater, in honor of his father, the late Franklin W. Olin, a Cornell civil engineering graduate in 1886. Mr. Olin, a director and member of the finance and executive committees of the Olin Mathieson Chemical Co., made the announcement following the sixth annual banquet of the Cornell University Council.

In acknowledging the gift, Cornell President Deane W. Malott declared that the new building will mark a long step toward completion of Cornell's new and completely integrated engineering college quadrangle. It will become the eighth in a group which will eventually include nine structures, all new within the past decade and all devoted to some branch of engineering.

Cornell's chemical engineering building, Olin Hall, is named for Spencer Olin's brother, the late Franklin W. Olin, Jr.; the University's dormitory facility at the Medical College in New York City, F. W. Olin Hall, is named for his father and is a gift of the Olin Foundation.

Construction on the new building is expected to begin in the spring.

Mr. Olin was first vice president of Olin Industries, Inc., from 1945 until the merger of that company with the Mathieson Chemical Corp. in 1954. He began his association with Olin Industries in 1921, following his graduation from Cornell with a degree in mechanical engineering.

He is vice president and a director of the U. S. Defense Corporation; a director of U. S. Cartridge Company, Texas Powder Company, U. S. Powder Company, Liberty Powder Company, Liberty Powder Defense Corporation, Equitable Powder Manufacturing Company, Bell Telephone Company, Columbia Powder Company, East Alton Public Service Company, Ecusta Paper Corporation, the Harwid Company, Illinois State Bank of East Alton, Laclede Steel Company, St. Louis Union Trust Company, and the First National Bank and Trust Company of Alton.

He is a native of Alton, Ill. During his college days he was captain of the Cornell golf team and a member of the Rifle Club. He is a son of the late Franklin W. Olin who was for many years a trustee of Cornell, and is the brother of John M. Olin, a trustee.

C. H. Smith

Deane W. Malott (left), president of Cornell University and Spencer T. Olin '21, donor of the University's new civil engineering building, and a director and member of the finance and executive committees of the Olin-Mathieson Chemical Company.

GRAD JOB OFFERS

In the first three weeks after their graduation with bachelors degrees in engineering, 136 members of the Cornell College of Engineering class of 213 found new jobs, and 128 of these reported starting salaries ranging from $396 to $860 a month. The salaries were based on a 40-hour work week.

Figures released by Donald H. Moyer, director of the office of student personnel at the College of Engineering show a median monthly starting salary of $450 for the 128 reporting graduates in chemical, civil, electrical, mechanical, metallurgical, and agricultural engineering and engineering physics. This compares with a median of $415 reported last year, and compares favorably with starting salaries offered to holders of master's degrees in engineering.

In addition to the 136 placements in the class of 1956, there will be 26 men entering graduate study, 15 will go immediately into military service without a job commitment, and 36 have not reported their immediate plans. Some others will also enter military service, but with guaranteed civilian jobs awaiting them. All the class members surveyed have completed Cornell's five-year course and have received bachelor's degrees. No estimate of the total number of job offers is available, but Mr. Moyer reported that some outstanding candidates received as many as 15 or 20 different proposals. He pointed out that graduates tend to show considerable discrimination in selected jobs, and that in the past three years some two thirds of Cornell's engineering graduates have taken jobs at salaries below the top offers they have received.

WINS H.C. FORD SCHOLARSHIP

Donald T. Farley, Jr. of Bronxville, New York has been selected the winner of the 1956-57 Hannibal C. Ford Fellowship for advanced engineering study at Cornell University.

One of the most highly prized awards for scholastic achievement, the Fellowship was established by Ford Instrument Company, Divi-

CORNELL SOCIETY OF ENGINEERS MEETING

on

October 29, 1956

at

THE ENGINEERS' CLUB,

40th Street, New York

Cocktails — 6:00 P.M.

Dinner — 6:30 P.M.

Meeting — 8:00 P.M.

Featured Speaker

J. O. MORSE, Director

Cornell Medical College

Topic: "Crash Injury Research"

sion of Sperry Rand Corporation to honor the name of Hannibal C. Ford, Class of 1903 at Cornell and founder of the company bearing his name.

Ford, whose inventions in computers and controls revolutionized naval warfare, built a company which today covers all forms of weapon control from missile guidance to aircraft navigation systems, from naval gunfire controls to Army Ordnance equipment. The firm also is active in nuclear reactor design.

Farley, this year's Fellowship winner, graduated number one in his class at Cornell in June. He has specialized in engineering physics and is a member of Tau Beta Pi, Phi Kappa Phi and Sphinx Head. Since entering Cornell fellowing his 1951 graduation from the Bronxville High School, he has been co-captain of track and president of Delta Chi fraternity.

ASEE MEETING

The 1957 meeting of the American Society for Engineering Education will be held at Cornell next June, with an attendance of about 2,500.

The announcement was made at the 1956 meeting in Ames, Iowa. Twelve members of the Cornell faculty attended.

Profs. N. A. Christensen and A. J. McNair are on the General Council and the Nominating Committee of ASEE. Professor Christensen presided at a conference of the Graduate Studies Division, and Professor McNair is on a joint committee on construction education, with members from ASEE and the Associated General Contractors of America, Inc.

Prof. E. M. Strong presided at a conference of Illumination Engineers, and Prof. L. P. Smith presided at a physics division conference. He also gave a paper on "The Objectives, Curricula and Results of the Cornell Engineering Physics Program."

PROFESSORS IN EUROPE

Prof. L. G. Parratt and Prof. Andre L. Jorissen of Cornell participated in conferences in Europe this summer.

Professor Parratt of the Department of Physics presented a paper at the Sixth Annual Reunion of the Physical Chemistry Society of France which met in Paris at the end of June. His paper was entitled "The Structure of Partially-Oxidized Thin Copper Films." The international conference had been called to discuss surface reactions of gases on metals.

Professor Jorisson, head of the Department of Hydraulics and Hydraulic Engineering, attended a meeting of the Committee on Flow Measurement of the International Organization for Standardization, held in Munich, Germany, July 8-14. He represented the American Standards Association and the American Society of Mechanical Engineers.

ROTC FELLOWSHIP

An ROTC fellowship plan intended to provide the Armed Forces with vitally needed scientific personnel has been established by Cornell Aeronautical Laboratory, Inc., of Buffalo, N.Y.

The Laboratory will award an annual fellowship to the outstanding ROTC student at Cornell who has qualified for a commission either in the reserve of one of the Armed Forces, or in the regular Army or Air Force.

With the permission of his branch of the Armed Forces, the fellowship recipient will pursue graduate studies at one of the University's engineering or scientific schools. The first fellowship winner will be selected from the 1956-1957 ROTC graduating class at Cornell.

T. P. Wright, President of Cornell Aeronautical Laboratory, said it is hoped the ROTC fellowship plan will receive support from American industry and be adopted by other ROTC colleges and universities.

"If the ROTC fellowship plan receives wide-spread support," Wright said, "it will provide the Armed Forces with a steady influx of highly trained engineers and scientists so vital to our national defense."

(Continued on page 46)

University of Southern California
University of California at Los Angeles

The California Division
of Lockheed Aircraft Corporation
presents its

Master's Degree Work-Study Program

Graduates in Engineering · Mathematics · Physics

The program enables you to attain a Master's Degree while gaining important practical experience on the engineering staff of Lockheed Aircraft Corporation.

The program in outline:

You carry at least six units per semester at the University of California at Los Angeles, University of Southern California or other approved universities. You work three days per week on Lockheed engineering or scientific assignments.

Eligible are U.S. citizens who are graduating with a B.S. degree in Aeronautical Engineering, Mechanical Engineering, Electrical Engineering (Communications or Power), Mathematics or Physics and members of the Armed Services who possess appropriate degrees and are being discharged.

You are paid 3/5 of a full-time salary during the school year. (Salary and work are on a full-time basis during school summer vacations.)

Tuition, fees and books for a maximum total of 36 units of full-time study are paid by Lockheed. *Travel and moving allowances are provided those residing outside the Southern California area.*

Additional information may be obtained from your Placement Officer or Dean of the Engineering School or by writing E. W. Des Lauriers, Employment Manager and Chairman of the Master's Degree Work-Study Program.

California Division

Lockheed

Aircraft Corporation
Burbank, California

One of Lockheed's new engineering buildings where Master's Degree Work-Study participants work on advanced aircraft development.

BRAINTEASERS

As a stimulant to those mathematical geniuses who are able to solve Brain Teasers, this year each month a free one year subscription will be given to the first person sending in a complete set of correct answers to the *Engineer*. So put pencil to paper and get going on these problems now.

1. A certain family party consisted of 1 grandfather, 1 grandmother, 2 fathers, 2 mothers, 4 children, 3 grandchildren, 1 brother, 2 sisters, 2 sons, 2 daughters, 1 father-in-law, 1 mother-in-law, and 1 daughter-in-law. There were only seven people present, however, instead of 23. How could this happen?

2. A friend of mine complained the other day that his watch was not keeping perfect time. He had noticed that the minute hand and the hour hand were together every 65 minutes. Was the watch gaining or losing time and how much per hour?

3. A farmer, having a son who would do little work, gave his son 50 potatoes and told him that as soon as the potatoes had been arranged in the following manner he would be free for the rest of the day. The son was to put all of the potatoes in a straight line. He was to take the first potato and set it beside the basket the potatoes had come in, put the second potato a yard in front of the first one, return to the basket and get a third potato to be placed 3 yards in front of the second, return again to the basket and get a fourth potato to be placed 5 yards in front of the third one, and to continue placing potatoes in this manner until all had been used. How far did the lazy son have to walk in all his trips to the basket and back?

4. Old Mrs. Smith had a patchwork quilt of 169 4-inch square pieces of cloth which was 13 pieces on a side. She wanted to divide this quilt into squares by cutting only the stitching. She also wanted to cut the quilt into as few pieces as possible. Bearing in mind these facts: the quilt could be cut only along the stitching, only in squares, and as few squares as possible, show how old Mrs. Smith could cut her quilt.

CRESCENT

Insulated Wires and Cables

Pictured here are just a few of the many wires and cables made by CRESCENT. They have an enviable reputation for quality and endurance.

CRESCENT INSULATED WIRE & CABLE CO.

TRENTON, N. J.

C. Edward Murray, Jr.

TECHNIBRIEFS

HEAT TREATING PRECISION PARTS

Manufacturers of small precision steel parts for instruments and aircraft can now finish machine parts *before* heat treating. This has been made possible by a heat treating innovation developed by the Allied Products Division of Hamilton Watch Co., of Lancaster, Pa. This new process permits heat treating even the smallest stainless steel parts to any desired degree of hardness or toughness without causing discoloration of surface finish or any dimensional distortion.

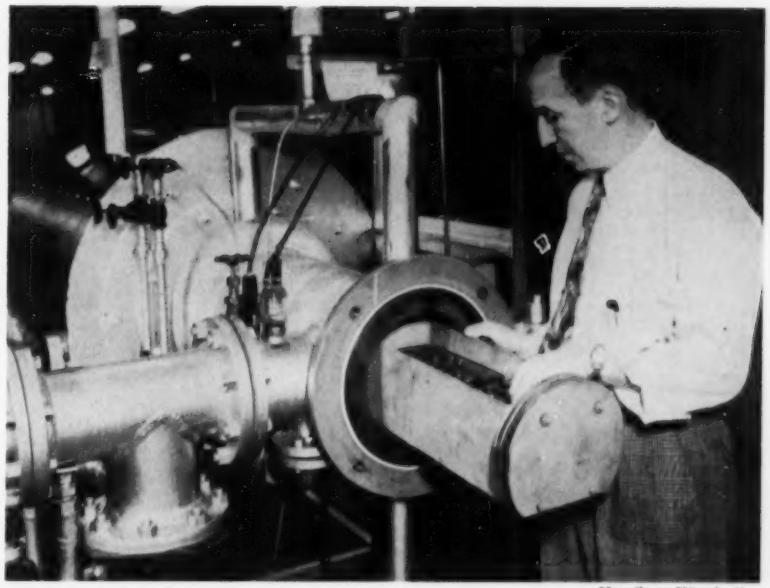
This recently developed process is effective for all hardenable grades of stainless steel. It will produce both toughness and hardness of any desired degree all the way through the metal.

The original research was done as an outgrowth of work on heat treating small stainless watch parts. Stainless steel is used in many watch parts, particularly in the numerous fastening screws used to hold the base plates and mounting elements together. The carbon steel screws previously used often corroded in place and occasionally the screw would break during disassembly, thus necessitating a difficult task of removing the broken stud.

The new process is achieved by precise control of the heat treating furnace atmosphere through special preparation of the atmosphere gases. Used in the furnace are dry hydrogen (dew pt. under −60°F.) or dissociated ammonia (dew point under −60°F.) for bright hardening, and vacuum for high temperature tempering. Dry hydrogen is used for annealing and vacuum is used for batch assembly.

Not only does this process prevent distortion of the minute parts, it can also be arranged to produce controlled growth or shrinkage in dimensions of the parts. The usefulness of this versatility has been demonstrated by restoring to correct size a batch of dimensional reject parts for jet engines.

The principal advantage of this process is that finish machining may be done before heat treating, while the material is still in the soft state. It also eliminates final machining and such secondary operations as cleaning and polishing the part after the material is hardened.



Hamilton Watch Co.

Tray of miniature precision stainless steel parts being fed into a special heat treating furnace.

LARGEST CESIUM-137 SOURCE

Completion of a 2000-curie cesium-137 gamma ray source was recently announced by Arthur F. Rupp, Director of the Operations Division at Oak Ridge National Laboratory. This is the second of two large cesium-137 sources to be produced at the Laboratory.

The first source, which contained 1540 curies of cesium-137, was completed in 1954 and is now in use for medical research at the Oak Ridge Institute of Nuclear Studies. The second source will be used in a fission-product utilization program at the University of Michigan.

Cesium-137 is the most important long-lived (about 30 years) gamma ray-emitting isotope found in the by-products of nuclear fission. It is expected that, in addition to the well-known medical applications, millions of curies will be used by industry in the future for radiography, pasteurization of foods and drugs, and catalyzing chemical reactions.

The radioactive cesium used in this source was chemically recovered from wastes resulting from the processing of reactor fuels and converted into dry cesium chloride powder. The powder was pressed at 20,000 pounds per square inch to form compact pellets. Three of the pellets were combined to make the final radiation source by placing them in a double-walled, stainless steel container which was double-sealed to produce a leak-tight capsule.

The 2000-curie source of cesium-137 was 3.18 centimeters in diameter and 3.75 centimeters high, weighing 91 grams and occupying a volume of 29.65 cubic centimeters. The specific activity was 22.4 curies of cesium-137 per gram of cesium chloride.

A pilot plant, designed to provide large-scale testing of processes for separation of fission products from reactor wastes, is now under construction at Oak Ridge National Laboratory. This plant will also expedite the preparation of large radiation sources.

When placed in operation about June 1957, the plant will be capable of separating and packing 200,000 curies per year of cesium-137.

In addition to cesium, large quantities of other fission products such as strontium-90, cerium-144, promethium-147, technetium-99,

Union Carbide & Carbon

Large cesium source being produced in a remote-control cell at Oak Ridge.

Pratt & Whitney

Vanes are fed from vertical magazine into shuttle and are then triggered into the rim of the circular shroud.

and ruthenium-106 will be separated in the plant. Sources containing thousands of curies of radioactivity can be prepared in a variety of shapes, such as long thin rods, flat plates, or hollow cylinders.

In all cases, the radioactive material will be hermetically sealed within double-walled, stainless steel containers to ensure against leakage.

When the new plant is placed in operation, it may be possible to effect a significant reduction in the price of cesium-137. The present price for large amounts of cesium-137 is about $14 per curie, not including the fabrication and special handling charges. Data obtained from semi-works operations indicate that pilot plant material may be produced for less.

JET VANE MOUNTING

Until recently, jet-engine vanes were most satisfactorily mounted in their metal shrouds by first punching a slot in the shroud and then inserting the vane.

After five years of development, it is now possible, using a Danby vane piercing machine, to fit the vanes into the shroud without punching the slot. This method is being used successfully at Pratt & Whitney Aircraft at the present time.

The principle of the machine, which is fully automatic, was inspired by a freak of Nature—the phenomenon of a straw driven by hurricane force through the trunk of a tree or telephone pole. In a single operation, the vane is driven at a velocity of six inches per second by a force of four tons into the inner circumference of the shroud. Instead of the conventional prepunched method, the Danby machine provides a one-way trip for each vane, making tolerances almost non-existent.

The hydraulically operated, seven ton machine was put into trial operation for two years, during which time it underwent constant modification and change. It was then put into production on a part-time basis with enough success to warrant the installation of nine additional machines at Pratt & Whitney.

The main stabbing operation is performed horizontally. After a circular shroud is positioned, the stabbing is performed radially from the center of the shroud. Vanes are fed from a vertical magazine into a shuttle and successively rammed home into the skin making up the shroud's perimeter. In a later manufacturing step, the vanes are driven through a second skin overlaying the first.

College News

(Continued from page 42)

SPRY TEACHES SUMMER CAMP

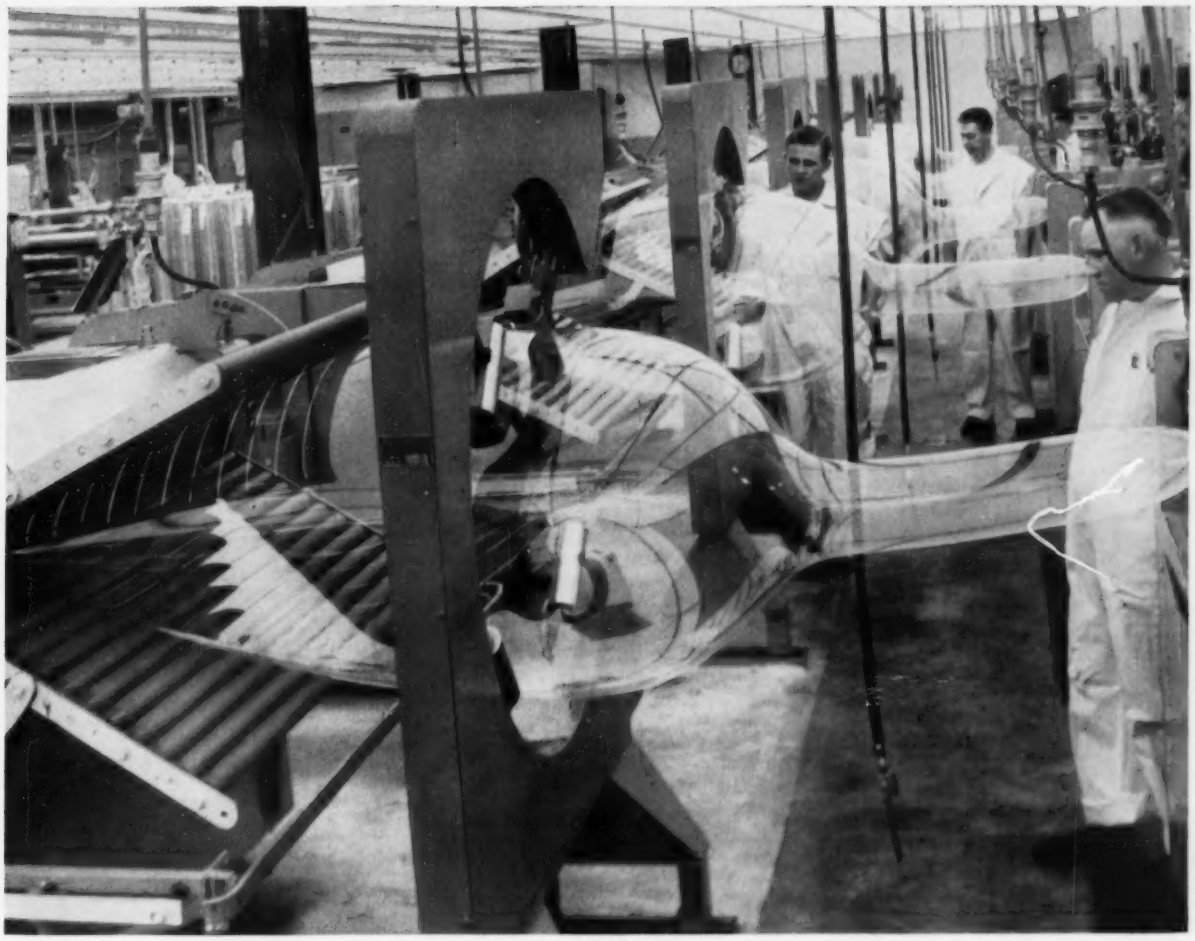
Prof. Fred J. Spry of Cornell, who became professor emeritus of civil engineering on July 1, was on the staff at his 32nd Cornell Summer Survey Camp at Lake Cayuta this summer.

Before that opened in August, he taught at the Manhattan College survey camp held in June at St. Joseph's, near Monticello. Unlike Cornell students who can practice surveying in their own backyard all year long, the Manhattan students get little practical experience except for this camp.

Professor Spry has made the most of his opportunities to combine work with outdoor life. After graduating from Lafayette in 1914, he spent six years as a maintenance of way engineer for the Lehigh Valley Railroad in Easton, Sayre and Auburn.

(Continued on page 67)

DOW



Saran Wrap is stretched by injecting compressed air to form a bubble ½ mil in thickness which is then compressed and wound.

Bubble, bubble, toil and brainwork...

Dow engineers create modern new plant for Saran Wrap production

Demand was multiplying for Saran Wrap. Housewives across the nation wanted more and *more* of this clear, moistureproof plastic wrap for foods. A new plant was needed . . . and needed fast.

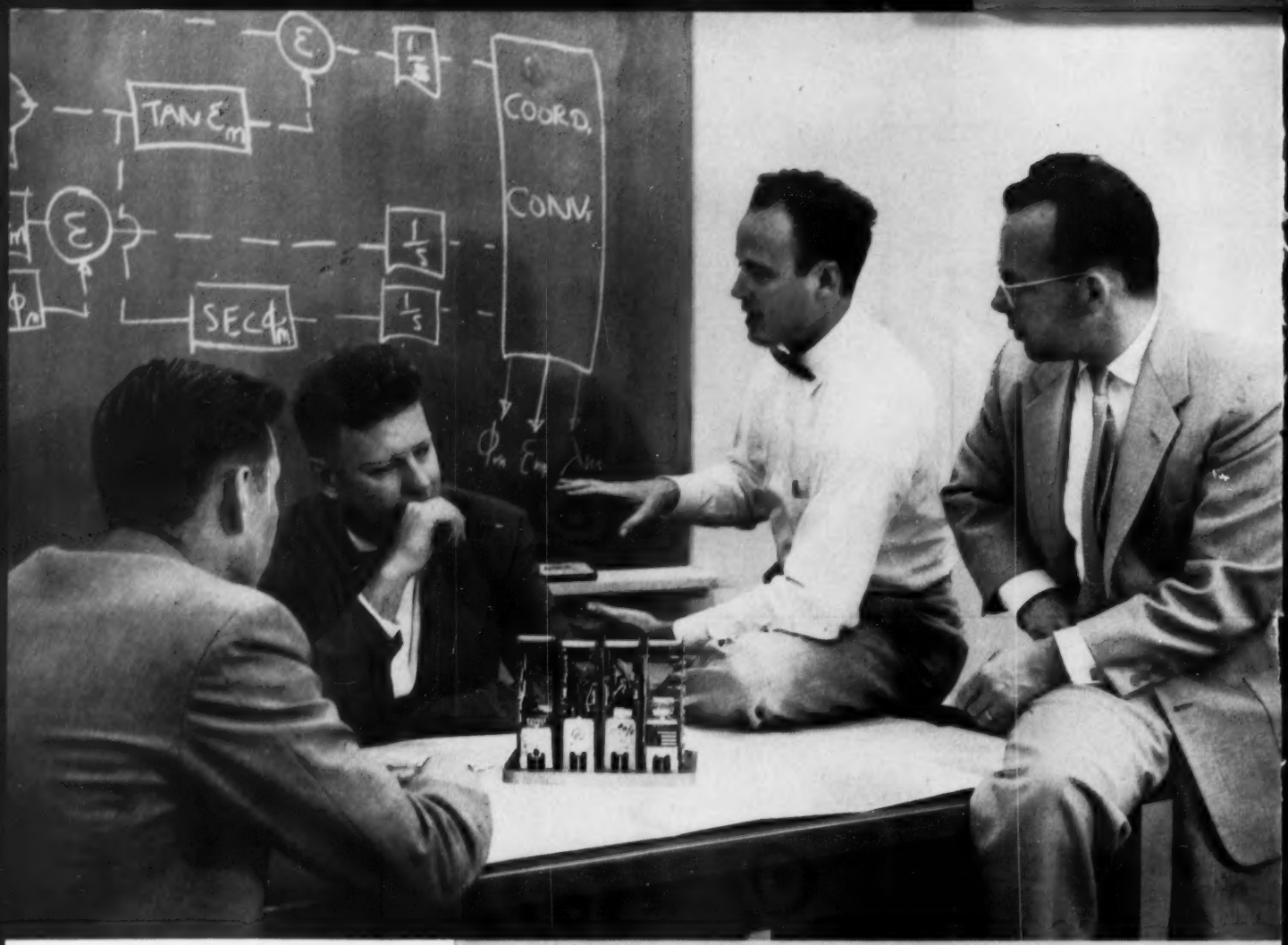
Dow's engineering and technical staff went to work. Production processes were checked and improved. Mechanical engineers designed new machinery. Electrical engineers introduced new fluorescent lighting (shielded by an entire ceiling of corrugated plastic) eliminating glare from Saran Wrap which would have tired the eyes. Modern plant innovations were widely apparent as the blueprints came in from engineer after engineer.

Then the job was done. Hard work and brainwork had produced an enviable new plant ready to produce in excess of 5,000,000 Saran Wrap rolls a month. Dow-engineered from start to finish, it stands as a testimonial to the depth and talent of Dow engineering and planning.

Dow is interested in all types of engineers and scientists who are considering a Dow future. And for the Dow sales program, in addition to engineers and scientists, those with partial engineering and scientific training are also needed.

Whether you choose research, production or sales, you can find a challenging career with Dow. Write to Technical Employment Department, THE DOW CHEMICAL COMPANY, Midland, Michigan or Freeport, Texas, for the booklet "Opportunities with The Dow Chemical Company"—you'll find it interesting.

you can depend on DOW DOW



G. D. Schott (second from left), Flight Controls Dept. Head, discusses new techniques in the mechanization of autopilots with R. D. Wertz (left), Flight Controls Research Engineer; R. J. Niewald, Flight Controls Analysis Section Head, and B. C. Axley, Servomechanisms Analysis Group Engineer.

MISSILE SYSTEMS FLIGHT CONTROLS

One of the most critical problems encountered in the development of a successful missile system involves attaining rapid responses of controls *consistent with system stability*. Moreover, it is a problem of increasing importance as new aerodynamic configurations require major advances in flight controls performance.

At Lockheed, Flight Controls engineers are developing unique control methods to cope with this growing problem. Their expanded activities have created new positions for those possessing experience and a high order of ability in:

- Hydraulic servomechanisms
- Circuit design
- Aerodynamic stability and control
- Flight analysis
- Autopilot simulation

Positions are open in flight controls and virtually every field of engineering and science related to missile systems.

Lockheed **MISSILE SYSTEMS DIVISION** *research and engineering staff*

LOCKHEED AIRCRAFT CORPORATION

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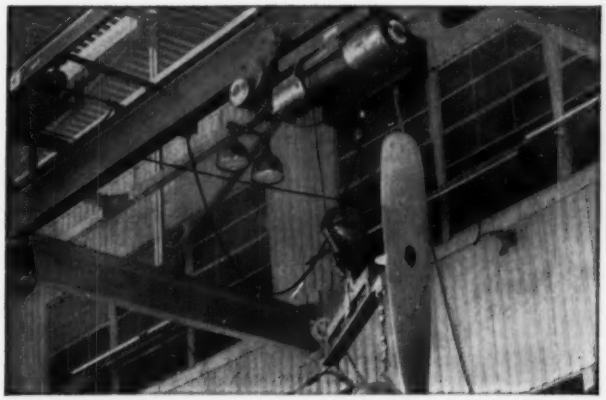
Another page for **YOUR BEARING NOTEBOOK**

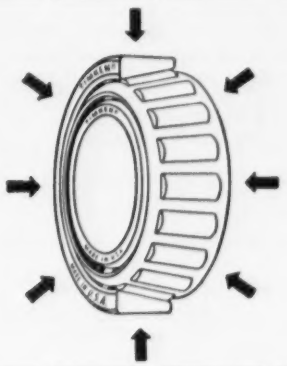
How to keep cranes flying



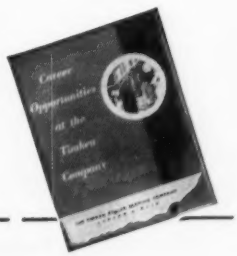
When engineers designed the overhead cranes for the world's largest line maintenance hangar, they faced the problem of taking the enormous thrust and radial loads imposed by swinging aircraft engines. To assure dependability, keep the cranes on the job, and keep the engines moving, they specified Timken® tapered roller bearings.

Tapered design lets Timken® bearings take both radial and thrust loads

Because of their tapered design, Timken bearings can take radial or thrust loads or any combination. And because the load is carried along a full line of contact between rollers and races, Timken bearings have extra load-carrying capacity.



Want to learn more about bearings or job opportunities?



Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "Career Opportunities at the Timken Company". The Timken Roller Bearing Company, Canton 6, Ohio.

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"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates, and former students and to establish closer relationship between the college and the alumni."

The Scientific Manpower Shortage

I will assume that all who read this message are acquainted with the serious shortage of scientific manpower in the United States. Hundreds of newspaper columns, reports, memoranda and pamphlets have been written by an equivalent number of commissions, committees, advisory boards and editors. The shortage exists, it is serious, it will get worse before improving, it is impairing the industrial strength of the United States.

What can you do about it? Actually you can accomplish much—at the only level where the problem will be solved—with your friends, neighbors and former teachers. I would like to ask that each of you, undergraduate and graduate of Cornell Engineering, spend a little time on one or all of the following. The sum total of your individual efforts in many communities will be of great assistance.

1. Report back to the principal and teachers of your secondary and primary schools. Point out, in a constructive manner, where your early training was inadequate and how it could be improved. Stress the importance of science and mathematics, and especially of having teachers for these subjects who can stimulate interest and the proper motivation.

2. Talk to the younger brothers and sisters of your friends and to the other youngsters in your neighborhood. Sell them on science and engineering, encourage them to take the correct secondary school courses leading to these professions.

3. Spend some time with your neighbors who are on the school board and the draft board. Stress the importance of good teachers and a proper curriculum with the former, and the importance of continuing the training of technical students with the latter.

4. Above all do everything you can in your community, through action and deportment, to slowly bring about the realization and acceptance of the professional status of the scientist and engineer.

WALTER L. HARDY
President

ALUMNI ENGINEERS

John N. Boyle, who formerly headed test work for G.E.'s Ordnance Department, has been named superintendent of manufacturing for the section. An employee of G.E. since 1942, Mr. Boyle formerly was assistant general foreman for Aircraft and Ordnance Systems Division test activities. He received his degree in 1942 as a B.S. in engineering.

Phil Kent, B.S. in E.E. '14, retired May 1 from his former position as executive engineer of Chrysler Corp. Since his retirement he has been doing some consulting engineering and sales representative work for some automotive parts and accessories firms, and just taking it easy around his yard playing a little golf.

Alan F. Williams, B.S. in C.E. '15, will personally conduct a tour to the Olympic games in Australia. He was active in athletics while at Cornell and seems to have continued his affection for sports. His hobbies inclue football, soccer, rugby, basketball, crew, handball, lacrosse, track and wrestling. He gets a chance to see some of these sports in action as he is an accredited official in the Pacific Coast, Rocky Mountain, and Far Western Athletic Conferences. In his spare time he is a licensed CE and a scout executive in Nevada and California.

Harry F. Hartman, B.S. in C.E. '26, is the new State director for Texas of the American Society of Civil Engineers, representing the San Jacinto branch. He has been with Humble Oil & Refining Co. at Baytown, Tex., since 1929 and for the past several years has been head of their engineering division.

Charles J. Baker, E.E. '27, is a consultant to machinery manufacturers on government and export matters. Before starting his own consulting business, he was for five years director of the machinery division in the Foreign Aid Program.

Mr. Robert D. Olt, M.E. '54, has recently joined the staff of the Speedway (Indianapolis) Laboratories of Linde Air Products Company, a Division of Union Carbide and Carbon Corporation. Mr. Olt's assignment is on Synthetic Crystal

Samuel Hunkin, B.S. in C.E. '17, president of Hunkin-Conkey Construction Co. of Cleveland, was the recipient of a special award at Pepperdine College in Los Angeles for that company's outstanding accomplishments in the construction of the Colorado River Aqueduct, the world's longest domestic water supply line.

Carlyle M. (Abe) **Ashley, M.E. '24,** chief staff engineer of Carrier Corp., Syracuse, has been named to the important post of president of the American Society of Refrigerating Engineers. Abe is responsible for more than forty patents in the field of refrigeration and air conditioning.

William L. Cressman, C.E. '27, '28, is assistant general manager of product divisions, Jones & Laughlin Steel Corp., Pittsburgh, Pa. He was formerly manager of Eastern sales, Armco Steel Corp., Middletown, Ohio.

Walter J. Staats, Jr., B.S. in M.E. '30, is co-owner of West Jersey-York of Merchantville, N.J., distributors for York Corp., a refrigeration and air conditioning firm.

Edwin C. Cubler, C.E. '22, is a project manager with Raymond Concrete Pile Co., New York City. He was formerly assistant general manager of West African Constructors in Monrovia, Liberia.

W. H. Peter, Jr.

Jack Fruchtbaum, B.S. in C.E. '17, has designed and is building a nuclear reactor for MIT.

Wilbur H. Peter, Jr., M.E. '43, has been elected a vice president of Square D Company and will become division manager of the Electric Controller Division in Cleveland. He joined Electric Controller and Manufacturing Company as a sales trainee in 1937 and has been works manager since the firm was merged into Square D last year as a division. He served as a field engineer in Electric Controller's Pittsburgh office for seven years and subsequently held various production and personnel responsibilities in the Cleveland plant.

Mr. Peter is a former national director of the Society for the Advancement of Management and served as president of the Cleveland chapter. He is active with the Works Managers Group of the Cleveland Chamber of Commerce, the Cleveland Yacht Club, and various other professional and civic organizations.

David G. Bowen, Jr., Chem.E. '50, has joined the staff of Esso Research and Engineering Company's economics division. Mr. Bowen is a member of the Cornell Society of Engineers, the American Institute of Chemical Engineers and the American Society of Testing Materials.

Four Cornell graduates have recently been elected to head the Niagara Machine and Tool works of Buffalo, New York.

George E. Munschauer, M.E. '27, has become chairman of the board and chief executive. He has been with the company since 1928, having served as treasurer and director since 1941 and vice-president since 1945.

Frederick E. Munschauer, Jr., M.E. '41, succeeds his father as president and general manager. He was previously a director and vice-president in charge of manufacturing and industrial relations.

Franklin A. Reed, M.E. '22, has been elected vice-president in charge of sales and **Edwin A. Munschauer, Jr., M.E.,** is the new treasurer and director.

A. H. Jackson

Mr. A. H. Jackson, M.E. '26, has been appointed vice-president-general manager of the Blaw Knox Company's Equipment Division Plant at Blawnox, Pa. Mr. Jackson joined Blaw-Knox in 1927. For some years he was sales manager of the Tower Department and during the past year served as manager of the Division's Engineering and Development Department.

L. Irving Woolson, M.E. '26, vice-president of the Chrysler Corporation and president of its DeSoto Division, has been appointed to the board of directors of the corporation. He has been with the company since 1928, coming up through various engineering positions. He was instrumental in the early design drawings of the first DeSoto engine. In 1936, he became the youngest chief engineer in the corporation, being at the head of the DeSoto staff.

Woolson was named factory manager of DeSoto in 1943. In that capacity, he supervised the engineering of bomber parts stampings in the DeSoto press plant, and the production of Curtis Hell Diver wing sections in the DeSoto assembly plant. In 1948, he was advanced to operation manager and in 1950 was appointed vice-president in charge of manufacturing and a director in DeSoto. He was elected president of DeSoto in September, 1952.

William P. Bamford, C.E. '33, has been appointed assistant manager of the Rossford, Ohio plant of the Libby-Owens-Ford Glass Company. He was formerly superintendent of general specialties at Rossford.

L. Irving Woolson

William C. Taylor, M.E. '23, vice-president of American Steel Founderies, New York City. He was transferred last October from the company's Chicago office, where he was district sales manager.

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GRAPHITE CRUCIBLES

HIGH-TEMPERATURE CEMENTS

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this was the last word in blast furnace blowers

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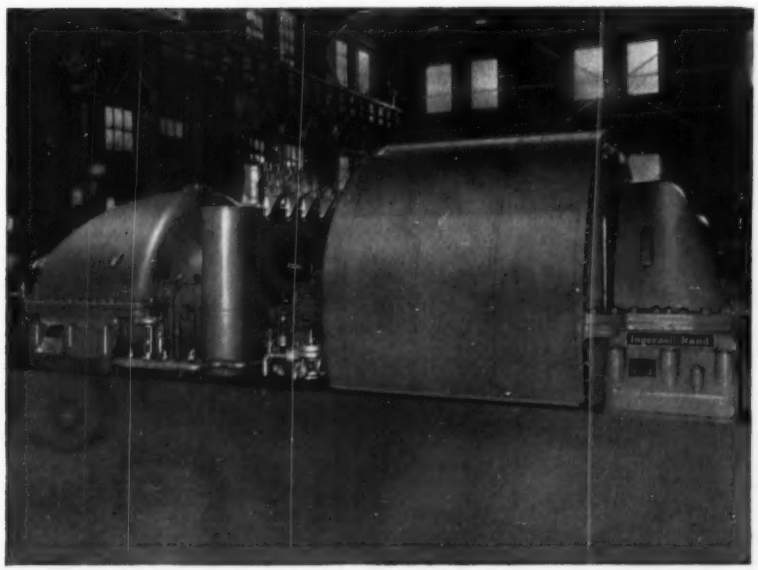
TODAY *it's the* TURBO-BLOWER...

another history-making development by Ingersoll-Rand



THE HUGE blast furnaces of today gulp air at 130,000 cubic feet per minute. For it takes *three tons of air* to produce a single ton of pig iron.

In steel plants from coast to coast, you'll find Ingersoll-Rand Turbo-Blowers on the job 24 hours a day, month after month, year after year. Their reputation for dependable performance is the result of Ingersoll-Rand's continuous research and development in the design and construction of air power equipment.

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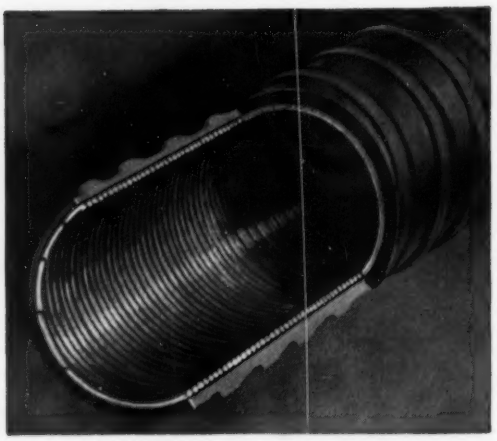
Communications Superhighways of the Future

Another example of the pioneering opportunities at Bell Telephone Laboratories



Experimental waveguide, of tightly coiled copper wire in jacket, takes waves around bends. Solid wall pipe can be used for straight runs.

Careers with Bell Telephone Laboratories offer young engineers and scientists the chance to take part in pioneering exciting new developments in the field of communications—developments that look ahead to the needs of the future.

For example, the Bell System anticipates greatly increased demands for the transmission of telephone conversations and TV pictures. Communication links of giant capacity will be needed. Bell Labs scientists and engineers are experimenting with a new kind of long distance transmission medium which consists of round waveguides—empty pipes—and is theoretically capable of carrying hundreds of thousands of telephone conversations simultaneously with hundreds of television programs.

One type of guide, designed to be flexible, is bent on wooden forms to study effect of curvature on transmission. Left is A. C. Beck, Radio Research Engineer, E.E., Rensselaer Polytechnic Institute. Right is A. P. King, Radio Research Engineer, A.B. in Physics and Engineering, California Institute of Technology.

A crucial difference between this new waveguide system and present systems is that the *higher* the frequency of the waves transmitted, the *less* the attenuation. This is exactly the reverse of what is true for other forms of long distance transmission, such as the coaxial cable. To explore at frequencies higher than any now used, Laboratories scientists are devising new techniques and apparatus. Thus, they have developed a new reflex klystron tube able to generate a wide band of frequencies near 60,000 megacycles per second.

This new waveguide system is another result of the Bell System's unending effort to anticipate America's future communications needs. Projects like this are typical of the challenges that offer absorbing careers to able, imaginative young engineers and scientists. Your placement officer has more information about careers with Bell Telephone Laboratories, and also with Bell Telephone Companies, Western Electric and Sandia Corporation.

BELL TELEPHONE SYSTEM

Book Reviews . . .

Introduction to Chemical Engineering

Walter L. Badger and Julius T. Banquero,

IX/753 pages. McGraw Hill Book Co., New York,

1955 ($9.50)

It is difficult to review this new book on the unit operations of chemical engineering without comparing it to the old edition of Badger and McCabe, published in 1937. This is probably not a serious crime since the older text has been a familiar standby to many, many chemical engineers.

Although the general format is largely the same as in Badger and McCabe, the material within has been extensively revised, expanded, and brought up-to-date. The chapters on distillation, absorption, and extraction have been especially enlarged. There are many illustrations and diagrams, some of which also appeared in the old text, and solved example problems in nearly every chapter. There are also unsolved problems at the end of most chapters.

In the preface the authors explain that this book is meant only for a beginning course in unit operations and hence there is given a rather limited amount of theoretical treatment. However, even for an elementary course, it is desirable that some more theoretical background might be given than appears in Badger and Banquero. This reviewer would have preferred more space devoted to the fundamentals of heat, mass, and momentum transfer and to the analogies between them before getting into the more specific operations themselves. Some of the space devoted to crushing and grinding, size reduction, and conveying might easily have been sacrificed for this purpose.

One might also criticize a certain ineptness, in a few places, in giving readily understood explanations of simple principles. In general, however, this is an excellent and much-needed revision of a standard text on unit operations and may easily become commonly used in many undergraduate schools.

Industrial Engineering Handbook

Harold B. Maynard, Editor-in-Chief

XIX/1504 pages. McGraw-Hill Book Co., New York

1956 ($17.50)

This book attempts to fill a long-felt gap in the literature of industrial engineering, that of a handbook which would supply a broad, authoritative treatment of the whole field of industrial engineering. It succeeds in this formidable task very well.

A total of 81 authors, each an expert in his or her field, have contributed to this volume, under the editorship of H. B. Maynard, President of the Methods Engineering Council. The book is divided into eight general divisions, which include sections on the industrial engineering function, methods, work measurement, predetermined elemental time standards, wage payment, control procedures, plant facilities and design, and some miscellaneous aspects of industrial engineering. Within these sections are chapters covering a wide range of subjects.

In fact, one could criticize some of the topics covered as being outside the scope of industrial engineering. However, Editor Maynard points out that the boundaries of this field are by no means clear; hence, the decision to include not only the usual techniques and functions of industrial engineering, but also many related interests in order to satisfy everyone.

As with any handbook, this is essentially a practical "how-to-do-it" book. The human relations factor is constantly stressed. Here is a book which will undoubtedly find its way onto the shelves of nearly every practicing industrial engineer. In addition it may be a valuable reference to many men in middle and top management positions.

"When I look over the fence...

"Since the day when man made his first brief airborne flight, the advance in aeronautics has been little short of fantastic. Tremendous achievements have opened new avenues of progress that were but idle dreams of yesteryear. We live in a new dimension!

"To the young men of today, these new avenues of progress in aeronautics and the related sciences reveal almost limitless opportunities for success. As an engineer in quite another field I am constantly drawn to look over the fence to see what I see. And I am fascinated with the great and fast-growing opportunities that are there. So much so, that to the potent message of a previous century, 'Go West, young man,' I am prompted to add ... 'Look *up*, young man, reach for the stars, for they lead to great things.'"*

CHARLES LUCKMAN
Partner – PEREIRA & LUCKMAN
Planning – Architecture – Engineering

Out of his own successful engineering career, Charles Luckman sets a sure course for today's trained young man when he says "reach for the stars."

In the aircraft industry, the expression is strikingly exemplified by the records of thousands of far-seeing young men who have graduated into secure positions that offer lasting success. What was yesterday's single field has today come to include a multitude of specialized sciences.

At Northrop Aircraft – world leader in the design and production of all-weather and pilotless aircraft – the young engineer is provided a host of activities from which to choose. Each offers success opportunities positively unbounded.

For detailed information regarding specific openings in your field of specialization, write Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., 1001 East Broadway, Hawthorne, California.

NORTHROP

Pioneers in All Weather and Pilotless Flight

**From an address to the American Society of Civil Engineers, Los Angeles, California*

Ideas grow and grow at

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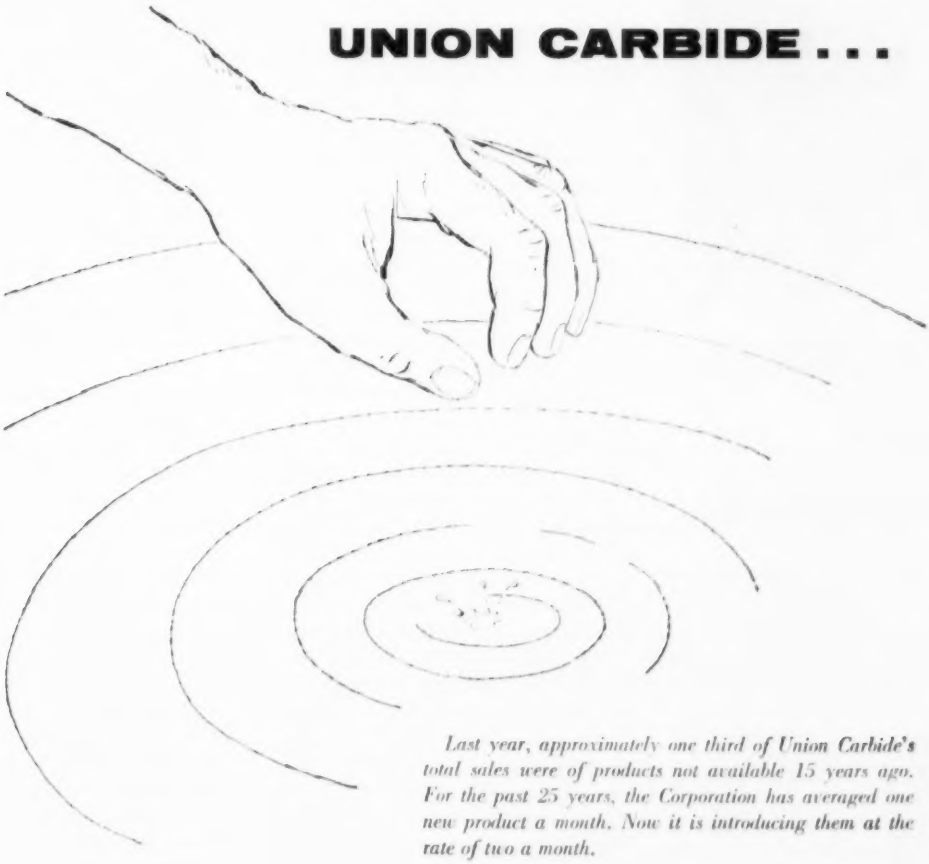

Last year, approximately one third of Union Carbide's total sales were of products not available 15 years ago. For the past 25 years, the Corporation has averaged one new product a month. Now it is introducing them at the rate of two a month.

Ideas born in Union Carbide Laboratories grow . . . from exploratory and fundamental research to applied research and product and process development . . . through pilot plants to production to sales. In all these fields the Divisions of Union Carbide need engineers, chemists, physicists, and business and liberal arts majors. For more information write Co-ordinator of College Recruiting.

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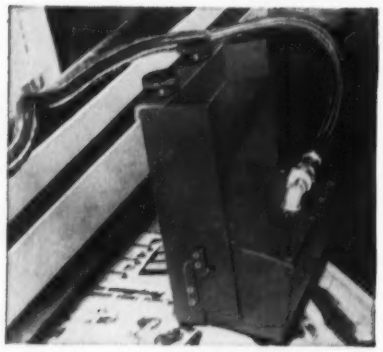
An idea to build your future

How to control printing register



with DENISON hydraulic equipment

CONTROLLING printing register on high-speed, four-color presses is a difficult and exacting task. An electronic register control system, utilizing Denison hydraulic equipment, has been developed which eliminates the guesswork, controls register to within .003 inches *automatically.*

Denison hydraulic pumping unit which powers this register control system.

A Denison hydraulic pumping unit furnishes the power to drive fluid motors which adjust printing rolls when distortion starts. Electronic signals "tell" the motors when adjustment is needed. The whole process takes less than .01 seconds. Instantaneous reaction to the electronic signals is one of the reasons hydraulic equipment was selected.

Ideas like these are solving many problems for industry, and developing greater need for hydraulic engineers. Investigate your opportunities in hydraulics. Write:

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American Brake Shoe Co.
1218 Dublin Road **Columbus 16, Ohio**

DENISON HydrOILics

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

TAU BETA

ART AS COMMUNICATION

by

Al Edelman, Grad. '59

We have at our command, many levels of communication. Communication can be so abstract, as in mathematics, as to be restricted to very few, or widely comprehended, as common speech. The pictorial arts are language for such emotional experience as cannot be communicated so well in any other way. The visual arts are flexible enough to be able to describe many of the subtle emotions, but must be concise enough to be plausible.

Man is usually quite sensitive to the most gradual changes in color, texture, sound and smell. His body can quickly adjust to the slightest changes in climate or environment. His experiences excite infinitely varying reactions, from sublime contentment to utter frustration and fear. But the reaction itself is not enough—it is far too transitory. Man feels he must communicate these feelings, perhaps in order to better understand them himself. His first reactions are felt in confusion and need clarification in order to be comprehensible. The ability to give form and color, understanding and permanence to an idea, is an essential part of man's makeup.

Each newly recognized experience leads to the realization of other emotions left unrecognized. There is a constant striving to sharpen the perceptive abilities in order to more fully communicate with others. Let us assume that communication is a basic human need and that art is one of the most intuitive means of expression. With this in mind, we can better understand many of the unusual art forms of past cultures and try and relate them to art activity today. In many of the primitive societies, art was either highly pictorial or stylized, and usually widely understood. There was a definite position for the artist to fulfill as an important part of these cultures. For instance, in the tribes of South Africa, sculpture had its own place in the rituals of birth, death, etc., as an integral part of the lives of all the tribe members.

In more recent times, this close connection between the artist and practical aspects of his society has changed. Each artist feels he must express himself in terms which others do not necessarily understand. He must invent his own methods and reasons. Our society has not yet had the courage to let the artist speak. It has not given him the confidence to speak without constant devastating criticism. This condition has produced two extremes in the visual arts: the attempt to communicate with everyone, which results in radio, television and magazine appeals and the purely intellectual, rather arid avant garde painting.

The Western tradition in art points out that the work of individual painters usually has meaning for his successors, therefore establishing a rhythmic sequence with the unusual painter stepping out of this tradition, rather than the usual. Through sympathy for the experience of others comes broader understanding and profitable lessons. This can be achieved through the art forms which, beyond the daily contact of people, provides the most significant connection for expressing what man cannot put in written or spoken form.

PI ESSAYS

THE HONOR SYSTEM

by Morton H. Friedman, Chem.E. '57

For many years, the question of instituting an honor system at Cornell has been, more or less, an academic one. To date, only the Civil Engineering school, among the dozen or so schools and colleges which comprise this University, employs the honor system. As of late, however, agitation throughout the University, and particularly in the Engineering College, has brought the honor system to the attention of many more students, and a University-wide honor principle is no longer a thought, but a real thing, which may be tested and put into effect very shortly. It is time, then, for a critical analysis of what effects such a system would have, and, more important, how the honor system would serve to improve the University.

These two points are clearly interrelated. Perhaps the best approach to answering the questions they pose would be to evaluate the reasons given in defense of the honor system.

In 1907, the honor system was introduced in the Civil Engineering school of the Engineering College at Cornell University. It was felt by the faculty of the school that engineers should have exceptional moral ethics, and consequently could be and should be placed on their own. Since the inception of the honor system, no more forceful or tangible arguments have been posed but these, and so it only is necessary that we consider the questions of engineering ethics and responsibility.

The argument concerning engineers' morality definitely places the cart before the horse; moreover, the cart is unreal. The student entering an engineering college is *not* an engineer. Even if we were to define engineers as being ethical, such a definition would not apply to the students in our colleges. And, what is more important, should be prematurely grant the student "morality by definition," we might be faced with an undesirable efflux of unethical students into the body of graduate engineers.

And engineers are not *all* ethical, besides. Were they, an appreciable amount of the patent litigation of the past decade would never have come about. If some engineers, fortunately in the minority, still try to evade the patent laws, why should we expect students to be more ethical.

The student, furthermore, is under even greater pressure to cheat (lacking a euphemism) than are graduate engineers, whose income and prestige are already secured. Such a fact is self-evident, and need not even be expanded upon. People who cheat now (and there are people who do) are not going to become honest when they are not supervised during an exam. Anyone unrealistic enough to think so is merely visionary. And a realistic approach in this case is simply based on human nature—it is not evidence of cynicism.

Is this a particularly strong or unusual opinion? Statistics would show not. Earlier this year a petition was passed around to all the Engineering Colleges, except Civil Engineering, asking the students whether they favored an honor system similar to that used in the Civil Engineering school. Only 29 per cent, less than one-third, of the students, answered in the affirmative*. A survey among the Civil Engineering students themselves indicated that only one-fifth of them would turn in a fellow student if they saw him cheat*, so even there the system is largely ineffectual. In view of the unrealism of the honor system, the lack of student sentiment in favor of it, and the imperfections in its operation, there seems to be no reason why the honor system should be expanded and the status quo not maintained.

*Telephone conversation with Jim Francis, Civ. E. '57, April 21, 1956.
**ibid.*

Hi Fi Records

(Continued from page 30)

This metal "master" is now lightly nickel plated to form a thin protective film and is coated with a molecular film of oxide. This oxide allows the subsequent coating of copper to conform pricisely to every contour without bonding to the nickel surface. (An application of a dichromate solution to the oxide makes the nickel passive.) After ten hours of copper plating the new replica, the "mother," is peeled away from the metal "master." Aptly named, because it is the "mother" from which a number of stamper plates are formed, the "mother" is an exact copper replica of the "master" which may be played to test the fidelity of reproduction thus far. Having passed inspection, the "mother" is nickeled and prepared for the making of the "stamper," the third metal part. The "stamper" is made on the mother in the same manner in which the "mother" was made from the "master." After removal from the "mother," the "stamper" is dimensioned, center punched and plated with chromium to provide a hard surface to resist the abrasive effect of the vinylite pressing material. Once mounted in the record die, the stamper is ready to turn out many pressings of vinylite or shellac under heat and pressure. Should a stamper show wear before the order is completed, a new one may be readily made from the "mother" which is catalogued and kept on file.

Prodigous progress has been made in the field of sound recording since Edison and Bell, it is true, but only with interest and knowledge on the part of the listeners will such progress continue. Too many enthusiasts know and care little or nothing about the records they play on their expensive hi-fi machinery.

Audiophile, know the *heart* of high fidelity—the record!

Bibliography

1. "The Recording and Reproduction of Sound" by Oliver Read
2. "High Fidelity" magazine
3. "Low Cost Hi Fi" by Donald Carl Hoefler
4. "Radio and Television News" magazine
5. "Popular Electronics" magazine

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load to the sample by means of dead weights and a lever arm system. (See figure 4) In order to achieve the magnitude of loading needed, the resulting apparatus consisted of a rather bulky loading frame and a delicately balanced lever arm system. The machine illustrated in Figure 3 replaces the dead-weight lever arm system with a load application device consisting of a hydraulically operated metal or rubber bellows system actuated by air pressure. The resulting equipment is compact and even portable as well as considerably easier to operate. Normally the results of a consolidation test are observed and recorded manually at intervals over a period of 24 hours. This particular test can even be refined a step further by attaching the electronic recording device also illustrated in Figure 3. This mechanism automatically records time versus consolidation data and eliminates some of the difficult scheduling features of consolidation testing due to the 24 hour observation period required. Also illustrated (see Figure 5) is a recently developed triaxial testing machine which differs from the more conventional machine in its design for bench operation and portability.

As to the future—new developments can be expected continually in all areas (exploration, testing and analysis) and standardization of the best ideas of all those people interested in the field will be ultimately accepted and put into general practice. The soils engineer has become a recognized specialist in the field of civil engineering. Modern building codes require the services of a qualified soils engineer in connection with foundation design problems and excavating, grading and filling operations. In at least one section of the country the Federal Housing Administration and the Veterans Administration require the services of a soils engineer on certain types of housing subdivision projects prior to authorizing FHA or VA funds. There are a great many opportunities for teaching and research work in the universities and Federal and State laboratories. Soils engineering is an excellent field for the civil engineer looking for real growth possibilities with the challenge of self expression.

Roads

(Continued from page 18)

should include complete schooling in road protocol, operation and first echelon maintenance of their vehicles before licenses to operate are issued.

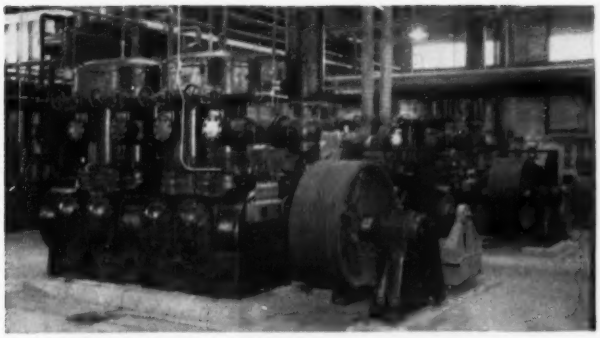
Many nations told of their individual training programs, sometimes aided by specialists from U.S. industry. Many resolutions were proposed, of which two stood out: one, that governments should raise their pay standards so that civil service would be more attractive to top notch men who generally turn to more lucrative work in private practice, and two, that the IRF compile and maintain an active file of the best in specialists of all fields to be internationally available until such time as each nation can fill its own needs.

Mr. H. S. Merriman of Socony-Mobil Oil, as chairman of the closing session, accepted a unanimous resolution that Count Leonardo Vitetti, the I.R.F. President at the Paris office present the full cooperation of the I.R.F. membership to the United Nations—this to be done in the form of a presentation of the complete proceedings of the Second Annual World Meeting in Rome. Surely this is a big step ahead because better roads do mean better living for every person on earth.

Soil

(Continued from page 34)

consolidation testing machine which applies some new principles to a standard laboratory test. This machine is illustrated in Figure 3. Consolidation testing is the means by which, through laboratory testing of undisturbed soil samples, settlements of structures—both as to magnitude and rate—are predicted. Formerly these tests were conducted by placing a soil sample in a consolidometer and applying a



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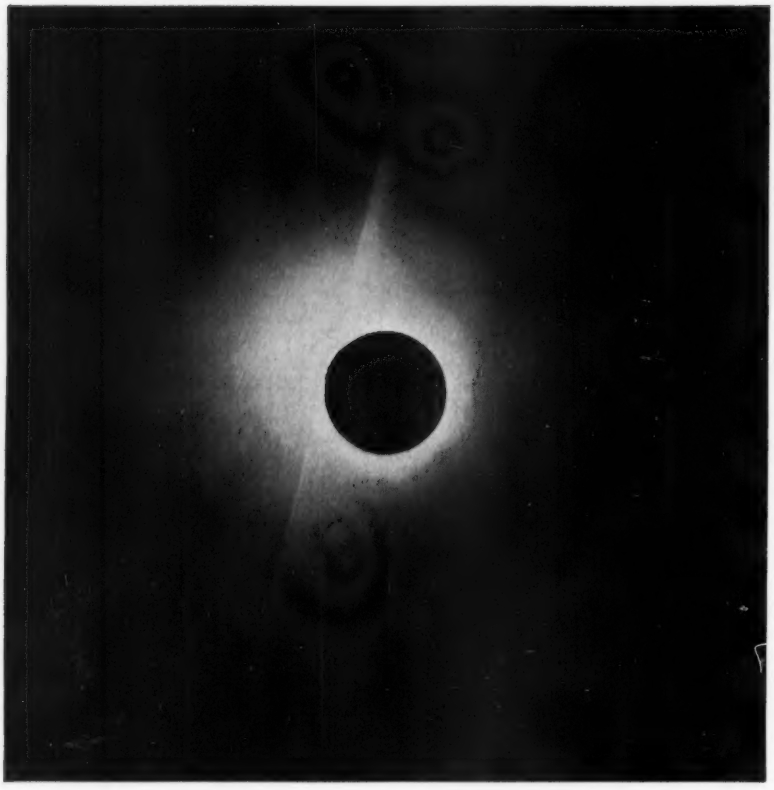

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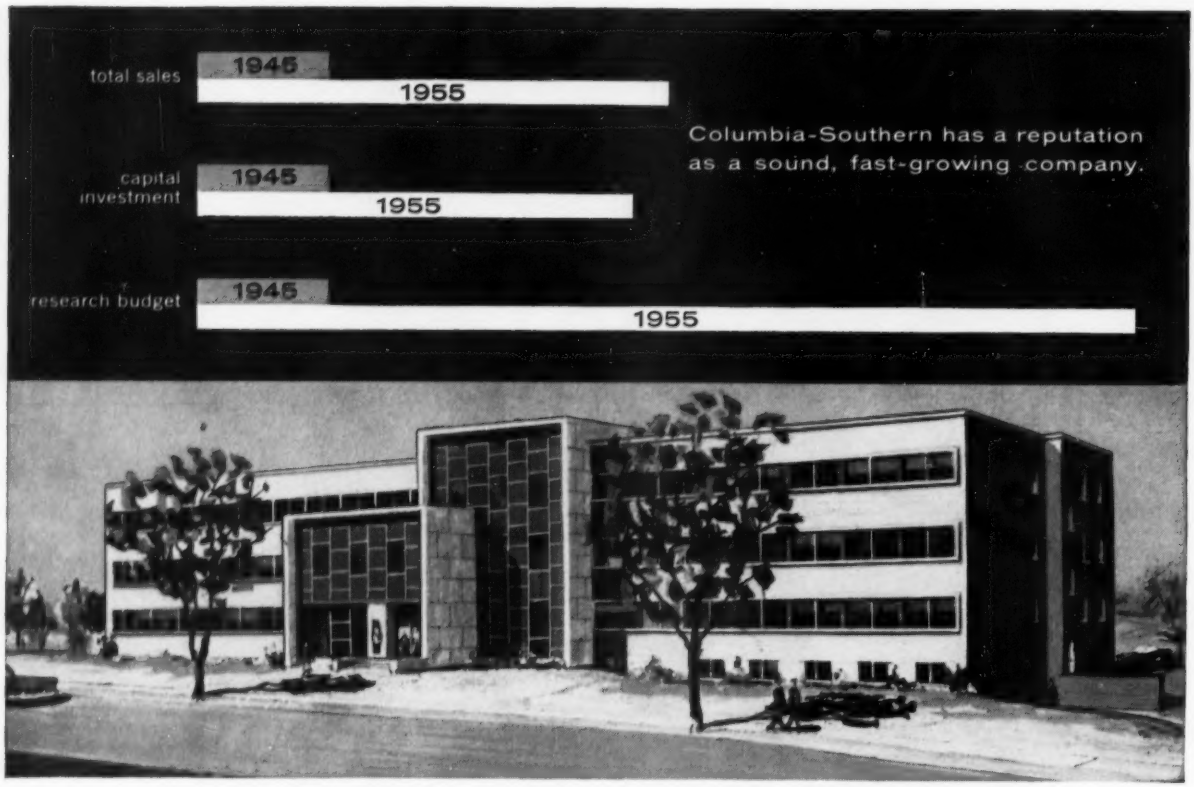

This new research and development laboratory in Barberton, Ohio, will be completed in early 1957. It is a part of Columbia-Southern's constant expansion program.

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Rhodes

(Continued from page 23)

phenanthrene, the recovery and purification of pyridine from by-product coke ovens, the making of pure meta-xylene, and the development and improvement of flotation oils for use in concentrating copper minerals from their ores. The modified flotation ores were used extensively in the porphyry copper mines at Bingham Canyon; Ray, Nevada; and Hayden, Arizona. While with the Barrett Company, he developed the divided-flow method for the operation of fractionating distilling columns and designed the first continuous fractionating column with side-stream draw-off. Among the projects that he prefers to forget was that involving the development and commercial introduction of a synthetic tanning agent. His comments on the aroma of a tannery on a hot August afternoon cannot be quoted here.

In 1920, Professor Rhodes returned to Cornell as Professor of Industrial Chemistry—at the princely salary of $3500 a year. In 1932, his title was changed to Professor of Chemical Engineering. In that year, the five-year program in chemical engineering was inaugurated, under the direction of a five-man committee of which he was chairman. In 1938, the School of Chemical Engineering was organized as one of the four schools of the College of Engineering, and Dr. Rhodes was made Director.

In 1942, Olin Hall of Chemical Engineering was completed and the School moved from the basement and part of the first floor of Baker Laboratory into its new quarters. The first staff in Chemical Engineering consisted of Professor Rhodes, one graduate-student instructor, and two graduate-student assistants.

The first class of Chemical Engineers graduated in June, 1933. It consisted of three men:

A. R. Graff, now President of Columbia Malting Company of Chicago.

V. K. Hendricks, now Vice-President of Hydrocarbon Research Corporation in charge of European operations of that company.

H. H. Peckham, now Production Superintendent of the Marcus Hook, Pa., plant of the General Chemical Division of Allied Chemical and Dye Corp.

In 1915, Professor Rhodes and Miss Ethel Bundy, of Ithaca, were married. They have one daughter, Mrs. Clara Rosevear, of Toronto, Ontario. Dr. Rhodes' hobbies include fishing, billiards, and draw poker. Another hobby—but one that he doesn't mention—is that of following closely and with interest the progress of the hundreds of graduates that he has known as friends and that have made outstanding records in industry, in research, in university teaching, and in fields outside of chemical engineering. The only pictures in his office are those of graduating classes of past years. (There used to be a somewhat moth-eaten mounted 3¼ pound speckled trout, but he got rid of that—he says that he wants a bigger one.)

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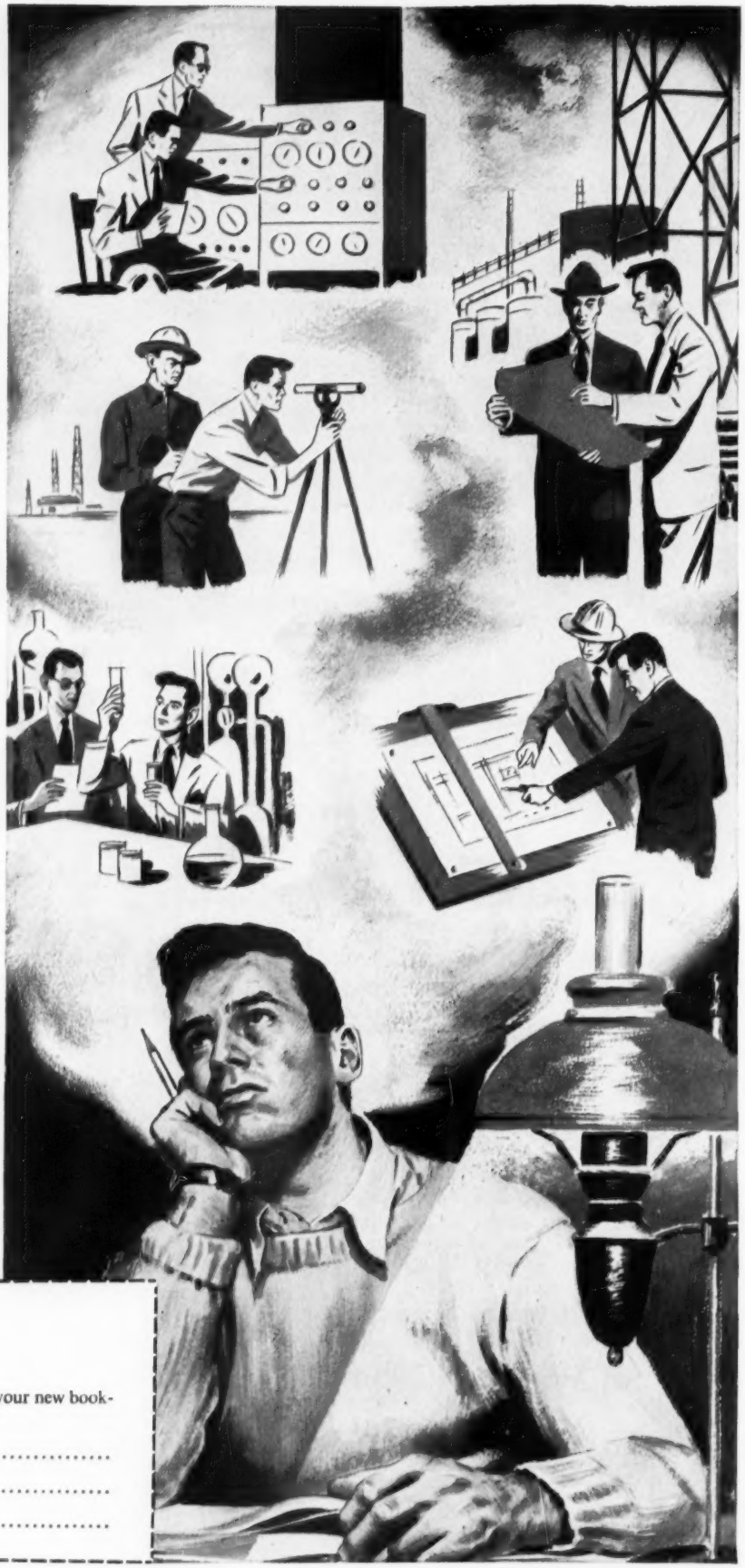

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College News

(Continued from page 46)

Professor Spry has taught at Cornell's School of Civil Engineering since 1923. He was on leave in 1944-45 to teach geodetic surveying in the Navy V-12 program at Swarthmore College.

Summer work has included powerhouse construction surveys near Hawley, Pa., pipe line surveys for the Herkimer Water Commission, and inspection work for the state health department in Oneonta and Poughkeepsie.

He was assistant city engineer in Auburn the year before becoming an instructor here, and has returned to that office two summers since. He has also helped out in the Ithaca city engineer's office and water department. He received a master of civil engineering degree at Cornell in 1929.

Professor Spry has been secretary of the faculty of the School of Civil Engineering for five and a half years, and just finished a term as president of the Central New York Section of the American Society of Photogrammetry.

MORDOFF BECOMES PROFESSOR EMERITUS

Prof. William E. Mordoff, who worked his way through high school in Rochester and college at Cornell, became professor emeritus of mechanical engineering on July 1 after 41 years on the Cornell faculty.

Graduating from the Sibley School of Mechanical Engineering in 1913, he taught physics for two years in Rochester's East High School, then returned to Cornell to teach rural engineering in the College of Agriculture.

In 1916 Professor Mordoff returned to the mechanical engineering faculty and for 18 years taught all the shop courses for freshmen, having as many as 187 students a semester in two three-and-a-half-hour laboratory periods each day.

About the time he was a student, he recalls, the university bought its

(Continued on page 69)

APPLICATIONS are now being accepted for...

1957 graduate student summer employment program for...

Experimental Physicists
Nuclear Physicists
Theoretical Physicists
Mathematicians
Metallurgical Engineers
Analytical Chemists
Inorganic Chemists
Physical Chemists
Mechanical Engineers
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Summer employment opportunities at the Laboratory are open to approximately 100 graduate students majoring in various physical sciences, and undergraduates receiving their degrees next June who intend to continue their advance studies.

The program provides for well-paid summer work with renowned scientists in one of the nation's most important and finest equipped research laboratories.

Summer employees will become familiar with several phases of vital scientific research and development activity related as closely as possible to the individual's field of interest. This experience will enable students to appraise the advantages of a possible career at the Laboratory.

In addition to interesting work, employees will enjoy delightful daytime temperatures and blanket-cool nights in a timbered, mountainous area, only 35 miles from historic old Santa Fe.

Interested students should make immediate inquiry. Completed applications must be received by the Laboratory not later than February 1, 1957, in order to allow time for necessary security clearance. Applicants must be U. S. citizens.

Travel expenses are paid to and from Los Alamos.

Mail inquiry to:
Department of Scientific Personnel

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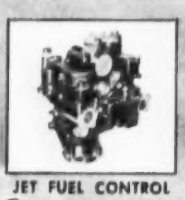
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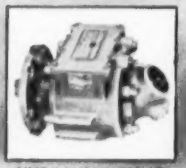
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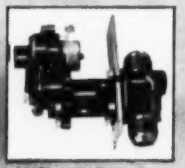
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HAMILTON STANDARD DIVISION

UNITED AIRCRAFT CORPORATION

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(Continued from page 67)

first automobile, a one-cylinder Cadillac, and soon thereafter bought a Ford touring car for the superintendent of buildings and grounds. Another memory is of President Andrew D. White, then retired, walking about the campus.

Working one's way through college was easier then, Professor Mordoff says, with a tuition of $150 a year. His brother Richard A. Mordoff, now a professor emeritus of meteorology, graduated from Cornell two years ahead of him.

Professor Mordoff was born in Scottsville, N.Y., 12 miles south of Rochester. Moving to Rochester, he spent one year in East High School then left school to work at the Ritter Dental Manufacturing Company.

After one year, he enrolled in West High School, graduating in 1909. He scheduled all his classes in the mornings, rode home for lunch on his bicycle, then off to Ritter, where he worked weekday afternoons and all day Saturdays.

Professor Mordoff expects that a lot of his new leisure time will go to the dogs, helping Mrs. Mordoff who is head of an Animal Emergency Club which cares for injured animals and finds homes for strays. They have had as many as 11 dogs at a time in their home at 104 Chestnut Street.

CAL STUDIES UHF SIGNALS

Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y., will study long-distance transmission of UHF (ultra high frequency) signals in a new program for the Electronics Research Directorate of the Air Force Cambridge Research Center, it was announced today. Technically known as a tropospheric scattering propogation program, the project will be carried out jointly by the Physics Department and the Engineering Service Groups.

In the past, scientists have con-

(Continued on page 71)

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The Ramo-Wooldridge Fellowships have been established in recognition of the great scarcity of scientists and engineers who have the very special qualifications required for work in Systems Engineering and Operations Research, and of the rapidly increasing national need for such individuals. Recipients of these Fellowships will have an opportunity to pursue a broad course of graduate study in the fundamental mathematics, physics, and engineering required for careers in these fields, and will also have an opportunity to associate and work with experienced engineers and scientists.

Systems Engineering encompasses difficult advanced design problems of the type which involve interactions, compromises, and a high degree of optimization between portions of complex complete systems. This includes taking into account the characteristics of human beings who must operate and otherwise interact with the systems.

Operations Research involves the application of the scientific method of approach to complex management and operational problems. Important in such application is the ability to develop mathematical models of operational situations and to apply mathematical tools to the solution of the problems that emerge.

The program for each Fellow covers approximately a twelve-month period, part of which is spent at The Ramo-Wooldridge Corporation, and the remainder at the California Institute of Technology or the Massachusetts Institute of Technology working toward the Doctor's degree, or in post-doctoral study. Fellows in good standing may apply for renewal of the Fellowship for a second year.

ELIGIBILITY The general requirements for eligibility are that the candidate be an American citizen who has completed one or more years of graduate study in mathematics, engineering or science before July 1957. The Fellowships will also be open to persons who have already received a Doctor's degree and who wish to undertake an additional year of study focused specifically on Systems Engineering or Operations Research.

AWARDS The awards for each Fellowship granted will consist of three portions. The first will be an educational grant disbursed through the Institute attended of not less than $2,000, with possible upward adjustment for candidates with family responsibilities. The second portion will be the salary paid to the Fellow for summer and part-time work at The Ramo-Wooldridge Corporation. The salary will depend upon his age and experience and amount of time worked, but will normally be approximately $2,000. The third portion will be a grant of $2,100 to the school to cover tuition and research expenses.

APPLICATION PROCEDURE

For a descriptive booklet and application forms, write to The Ramo-Wooldridge Fellowship Committee, The Ramo-Wooldridge Corporation, 5730 Arbor Vitae Street, Los Angeles 45. Completed applications together with reference forms and a transcript of undergraduate and graduate courses and grades must be transmitted to the Committee not later than January 21, 1957.

The Ramo-Wooldridge Corporation

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College News

(Continued from page 69)

sidered that transmission of UHF signals was limited to relatively short distances by the "radio horizon." For TV purposes, for instance, the transmitting and receiving antennas must "see" each other with no large obstacle in the way.

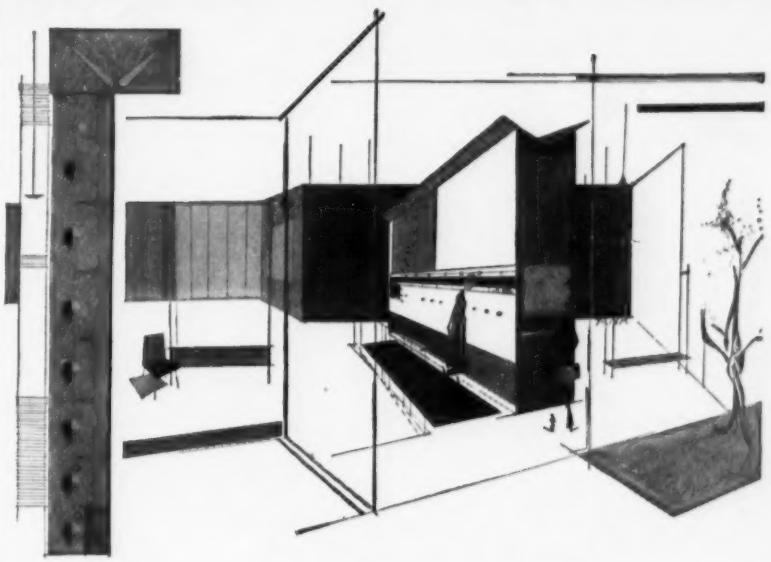
Recently it has been discovered that a small part of the signal is scattered in the troposphere, the lower part of the atmosphere within 60,000 feet above the earth. Beyond the "radio horizon" these signals can be captured using large antennas and very sensitive radio receivers. Scientists hope the scattered signal will be sufficiently strong during daily and seasonal variations of the troposphere to establish reliable long distance communications. If reliable transmission can be established, then additional frequency channels of communication will be available in our already overcrowded radio frequency spectrum.

Cornell Laboratory will set up a receiving antenna on the south shore of Lake Ontario, near Wilson, N.Y., to pick up a 915-megacycle signal from Lexington, Mass., 395 miles distant. This signal will be monitored for 48-hour periods each week throughout a year's operation. Processed data and analyses will be forwarded the Air Force Cambridge Research Center. It is hoped that this data will lead to refined theories on the atmospheric scattering of signals beyond the horizon.

Two methods of recording data will be used. Totalizer equipment will give the total time that the signal exceeds the present channel thresholds and will present quantitative data. An Esterline-Angus recorder will provide continuous records of signal strength and will give data on variations in the transmission path.

C.A.L.'s Physics Department has been active for several years in investigation of electronics, radar systems and atmospheric physics.

MARS outstanding design **SERIES**



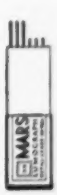
chef-less restaurant

This concept of Sue Vanderbilt, Pratt industrial-design graduate now designing GM auto interiors, would assemble a whole meal and cook it by microwave in a few seconds. Customer would merely check picture menu, insert money, push buttons. By the time he reached the far end of the counter the meal would be waiting, piping hot. All components already exist.

Many designs that will make news tomorrow are still in the "bright idea" stage today. No one knows which will flower into reality. But it will be important in the future, as it is now, to use the best of tools when pencil and paper translate a dream into a project. And then, as now, there will be no finer tool than Mars—sketch to working drawing.

Mars has long been the standard of professionals. To the famous line of Mars-Technico push-button holders and leads, Mars-Lumograph pencils, and Tradition-Aquarell painting pencils, have recently been added these new products: the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman's" Pencil Sharpener with the adjustable point-length feature; and — last but not least — the Mars-Lumochrom, the new colored *drafting* pencil which offers revolutionary drafting advantages. The fact that it blueprints perfectly is just one of its many important features.

The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom colored *drafting* pencil, 24 colors.



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Boeing engineers design America's first jet transport

Pictured above is the full-scale cabin mock-up of the Boeing 707, America's *first* jet transport. In developing this interior, Boeing engineers helped design features and innovations as advanced as the 600-mile-an-hour performance of the aircraft itself.

Pioneering revolutionary new types of aircraft like the 707 is one of the sources of excitement — and satisfaction — that engineers and scientists enjoy at Boeing. This new jet-age transport has already been ordered by 10 major overseas and domestic airlines. These commercial orders, together with Boeing's tremendous backlog of military contracts, mean that this company will continue to expand during the years ahead.

Growth is a Boeing habit. During the past 10 years, for instance, the number of Boeing engineers has increased 400%. Expansion at this rate spells job stability — and plenty of opportunity to move ahead. Boeing promotes from within, and holds merit reviews every six months to give each engineer a *personal* opportunity for recognition, advancement and increased income.

Boeing engineers don't get lost in the crowd. They work in small integrated teams — on such projects, in addition to the 707, as the advanced B-52 and B-47 multi-jet bombers, the BOMARC IM-99 guided missile, the 502 gas turbine, and other developments still under security wraps.

Qualified engineers and scientists of *all* types are needed at Boeing — now. You'll find high starting salaries, and stimulating contact with men outstanding in the world of engineering. Other advantages include liberal insurance and retirement plans, and a choice of modern, young-spirited communities in which to live. Boeing helps arrange special work schedules for engineers taking graduate studies, and pays all tuition and fees. You're missing a bet if you don't at least *find out* how Boeing can help you get ahead in your engineering career.

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Production Trainee Harold Taylor, Jr., MIT '52, B.S. in Metallurgy, left, and J. H. Mayer, Assistant Superintendent, Blooming Mill, observe the shearing of a slab on a hydraulic upcut shear at J&L's Pittsburgh Works

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It has been said that few industries give young engineers so much responsibility so early in their careers as the steel business. This is particularly true at J&L.

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Trainee programs are available also for graduates in Metallurgy and Chemistry, Design and Development Engineering and Industrial Engineering.

For further information about the job opportunities at J&L, consult your college placement bureau, or write to Dept. B-7E, Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pa.

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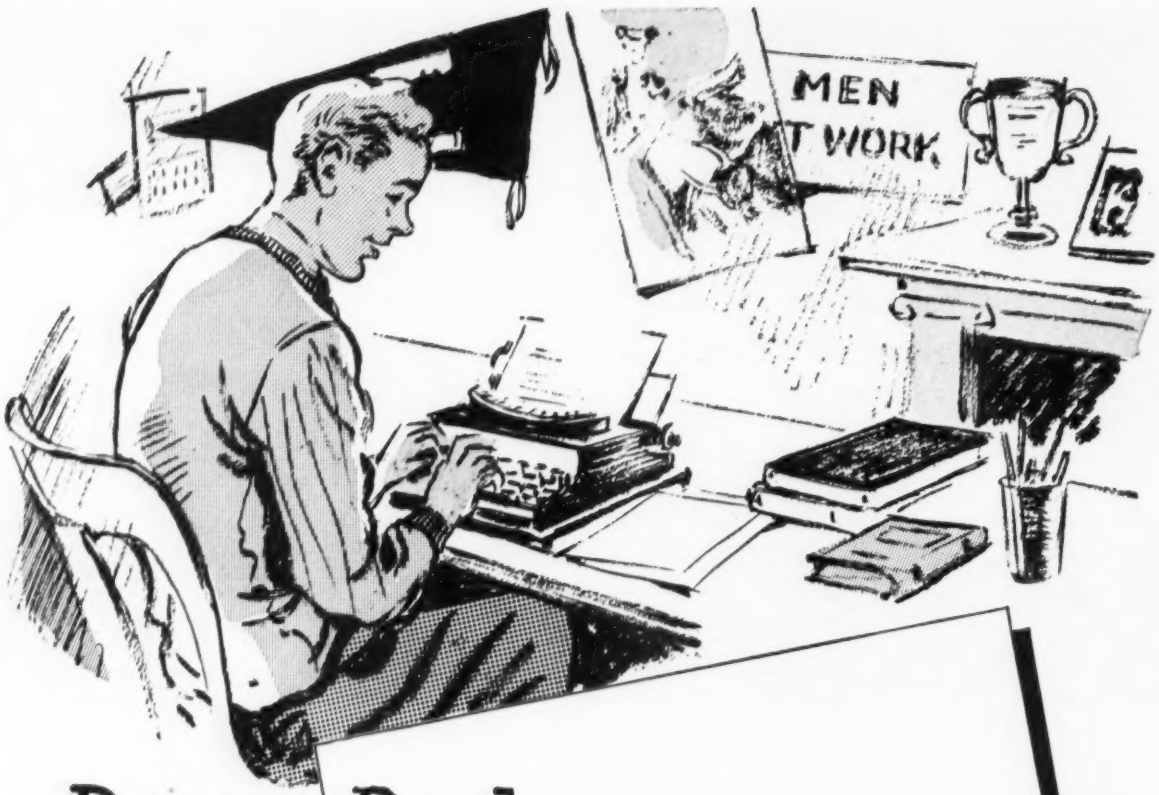
Send for free copy of "The Steel Industry—A Challenge to You," an address by C. L. Austin, Vice Chairman of the Board, Jones & Laughlin Steel Corporation.



Dear Dad,

Since I last wrote to you, I've been thinking about where I would like to live as well as where I would like to work.

Bob - you remember him - comes from New Jersey. He's been telling me a lot about it and it all adds up as a good place to live.

Public Service Electric and Gas Company - one of the country's more important utility companies - serves a section of the state between Philadelphia and New York. The Company has excellent training courses for Cadets in its Electric and Gas Operating Departments, in Sales Engineering, and in Commercial Management work.

As Bob says, New Jersey has everything for pleasant living: seashore and mountains for recreation; New York and Philadelphia for big city culture - the Metropolitan Opera - Philadelphia Symphony, etc. He says home life in smaller localities is happy and congenial (you know how Mary likes that kind of life and, after all, I must take her into consideration).

Don't be surprised if I write to you that I've taken a job with Public Service in New Jersey. It sounds good to me.

Affectionately

Bill

Representatives of Public Service Electric and Gas Company will visit your campus sometime in the near future. They will be glad to tell you about the company's job opportunities.

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Please send me literature on New Jersey and job opportunities with Public Service.

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Not enough to go around

How times change!

Not so very long ago, an engineer struggled to obtain a degree. Yet afterwards he just couldn't find a job that would let him utilize his hard-earned knowledge, much less start to build a career. Today, however, the demand for engineers exceeds the supply . . . so much so that there are not enough to go around.

We need engineers and skilled technicians. That hundreds of other companies do, too, is extremely well evidenced merely by thumbing through your newspapers and magazines. Why should you choose us above them? Perhaps you shouldn't. Neither should you come to that decision without first becoming fully aware of our record . . . who we are, what we do, where our future lies. For, in whatever field you choose to pursue a career, your transition from neophyte to veteran will not depend on ability alone. Without ample opportunities to demonstrate your talents, you'll not be able to prove your potential value in any industry.

We would like to tell you about our company. We hope, too, that you will reciprocate and give us the opportunity to evaluate you. You can do this by writing to Mr. Richard Auten, Personnel Department.

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STRESS *and* STRAIN . . .

Engineers' Glossary of Terms

It is in process—So wrapped up in red tape that the situation is almost hopeless.

We will look into it—By the time the wheel makes a full turn, we assume you will have forgotten about it also.

A program—Any assignment that cannot be completed by one telephone call.

Expedite—To confound confusion with commotion.

Channels—The trail left by interoffice memos.

Coordinator—The guy who has a desk between two expediters.

Consultant, Expert—Any ordinary guy more than 50 miles from here.

To activate—To make carbons and add more names to the memo.

To implement a program—Hire more people and expand the office.

Under consideration—Never heard of it.

A meeting—A mass mulling by master minds.

A conference—A place where conversation is substituted for the dreariness of labor and the loneliness of thought.

Under active consideration—We are looking for it in the files.

To negotiate—To seek a meeting of the minds without the knocking together of heads.

Re-orientation—Getting used to working again.

Reliable source—The guy you just met.

Informed source—The guy who told the guy you just met.

Unimpeachable source—The guy who started the ugly rumor originally.

A clarification—To fill in the background with so many details that the foreground goes underground.

We are making a survey—We need more time to think of an answer.

To note and initial—Let's spread the responsibility for this.

See me, Let's discuss—Come down to my office, I'm lonesome.

Let's get together on this—I'm assuming that you're as confused as I am.

Give us the benefit of your present thinking—We'll listen to what you have to say as long as it doesn't interfere with what we've already decided to do.

Will advise you in due course—If we figure it out, we'll let you know.

To give someone the picture—A long, confused inaccurate statement to a newcomer.

With modifications — Will be shipped to you in kit form. Put together (if you can) yourself. Glue optional.

* * *

There is only one engineer who ever got rich. He recently died in Colorado and left a fortune of $50,000, which he amassed through unceasing toil, superhuman perseverance, remarkable ingenuity, and the death of an uncle who left him $49,000.

* * *

He only drinks to calm himself,
His steadiness to improve.
Last night he got so steady,
He couldn't even move.

* * *

A sweet old lady, always eager to help the needy, spied a particularly sad-looking old man standing on a street corner. She walked over to him, pressed a dollar into his hand and said, "Chin up."

The next day, on the same corner, the sad old man shuffled up to the lady and slipped ten dollars into her hand.

"Nice picking," he said in a low voice. "He paid nine to one."

* * *

A divinity student named Tweedle
Refused to accept his degree.
He didn't object to Tweedle,
But he hated to be Tweedle, D.D.

Cannibal: "We've just captured a college professor."

Chief: "Good, I was hoping for a bologna sandwich."

* * *

A canny Scot was engaged in an argument with the conductor as to whether the fare was to be five or ten cents. Finally the disgusted conductor picked up the Scot's suitcase and tossed it off the train just as they were crossing a long bridge. It landed with a mighty splash.

"Hoot mon," screamed the Scot. "First you try to rob me and now you've drowned my little boy!"

* * *

The Russian school teacher asked a pupil who the first humans were.

"Adam and Eve," the kid replied.

"And what nationality were they?"

"Russian, of course," said the kid.

"And how do you know," asked the teacher.

"Easy," the kid replied, "They had no roof over their heads, no clothes to wear, and only one apple between the two of them—and they called it Paradise!"

* * *

The family had overslept, and Mrs. Smith woke with a start to the clanking of cans in the street. She remembered that the garbage had not been put out and raced down to the front door, struggling into a robe, with her hair in curlers, and looking rather sleepy-eyed.

"Yoo hoo," she called, "Am I too late for the garbage?"

"No," shouted the collector, "Jump right in."

* * *

All the animals came to Noah's Ark in pairs. Except the worms—they came in apples.

* * *

"Every week for the past two years my mailman has delivered 50 pounds of muscle-building equipment to me."

"And now?"

"Now I have the world's most perfectly developed mailman."

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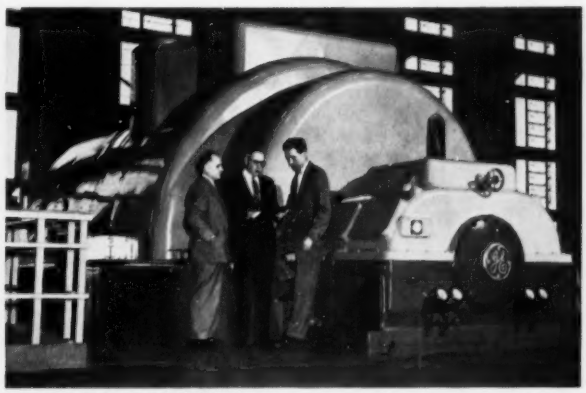

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